SPARK

REPORT

STRATEGIC
PLANNING
FOR
APPLIED
RESEARCH
AND
KNOWLEDGE

Science
Council of
British
Columbia

"INCREASED VALUE FROM A CHANGING RESOURCE"

and

"CREATING THE CLIMATE FOR INNOVATION"

Planning Reports of the Forests and
Forest Products Sector Committee

Prepared for

The Science Council of British Columbia

April 1988

OVERALL GUIDE TO THESE REPORTS

Included in this book are two separate but related reports prepared for the Forests and Forest Products Sector Planning Committee of the Science Council of B.C.

1. "Increased Value from a Changing Resource"

   - white pages are the body of the report
   - green pages are the Executive Summary and the Recommendations

2. "Equipment Suppliers to the B.C. Forest Industries: Creating a Climate for Innovation"

   - blue pages are the report

3. Copies of viewgraphs of the recommendations of other Science Council of B.C. Sector Planning Committees.

   - gold pages

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1. EXECUTIVE SUMMARY

The forest industry is the largest single economic sector of the provincial economy. It is the major employer, the driving force for many other economic sectors and is by far the largest part of the province's vital export industry. It competes in an expanding world wide market. Many strengths exist now in the B.C. forest industry which provide a basis for expanding investment and employment, not only in this sector but also in secondary, high technology industries.

This complex industry consists of separate yet interacting sectors namely, forestry, wood products, pulp and paper, machinery and equipment and consulting. The industry has not had to place a high priority on science and technology in the past due to the availability of large stocks of prime timber and the predominance of commodity products. Now each sector must increase its use of advanced technology to enhance the economic benefit to be derived from a changing and more expensive resource base and to add value to its products which compete on a world wide basis with products developed from new fibre sources.

The climate needs to be enhanced in the industry to foster further technological development within each sector and across the sectors. By using the local high technology industries, on a competitive basis, the B.C. forest industry can be at the leading edge of product and equipment developments and can fully coordinate its requirements with the local suppliers.

In order to continue its growth, all elements of the forest industry will need to agree on a long term goal for science and technology in the industry, encourage technological developments within each sector; promote greater interaction and co-ordination between its sectors; improve the economic return from its timber resource; add to its commodity product focus, quality value added products; and increase its technological competence and awareness, particularly the development of a positive environment for innovation in order to improve technology transfer.

In order to foster this climate for technology and innovation, the forests and forest products sector needs to adopt the following mission for science and technology in B.C.:

> **"Recognizing the changing nature and increasing cost of its timber resource and the changing needs of its world-wide customers, retain competitively priced commodity products and develop value-added products by the increasing use of innovative technology, advanced machinery and systems, consulting, training and education."**

In order to achieve this mission, the Committee recommends that the forests and forest products sector focus on achieving the following five goals:

- a commitment to the continuing expansion and enhancement of the forest industry as the ongoing driving force for the B.C. economy;
- the continued development of value added forest products and an increase in the economic returns of the forest resource through the application of science and technology. This recommendation supports the thrust of the recent changes to the Forest Act in this province;
- an improvement in technological competence and awareness throughout the industry;

- an improvement in the transfer of technology to expedite economic benefit;
- an increase in the competitiveness of the forest industry by promoting the development of relevant high technology industries in the province.

This mission needs to be adopted and the goals reviewed and accepted by the industry, governments, universities, colleges, research institutions, advanced machinery and technology suppliers and consultants and then aggressively pursued and implemented on a co-ordinated basis. This committee recognizes that the forest industry across Canada and particularly in B.C. is currently focussing strategically on its future goals and strategies and that the recommendations of this report need to be coordinated fully with other initiatives.

2. INTRODUCTION

The Science Council of British Columbia established a series of sectoral planning committees in early September 1987, based on its already existing Assistance Grants for Applied Research committees, to identify opportunities for improving the application of science and technology to the economy of B.C. These committees comprising representatives of industry, universities and colleges, research institutions and government, were to develop specific sectoral plans for the application of science and technology. The recommendations of each committee were to be integrated into overall plans for science and technology by the Premier's Advisory Council on Science and Technology and by the provincial government.

The objective of the Forests and Forest Products Sector Plan is to identify important issues and key strengths and to make broad recommendations regarding the application of science and technology in this industry. Detailed investigations of specific opportunities or resolution of problems identified will occur subsequently once priorities have been established.

The following are members of the Forests and Forest Products Sector Planning Committee who actively participated in the development of this report:

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Equipment Suppliers Study

As noted in the opening statement concerning this document, a separate but related study was undertaken concerning equipment supply. This study was conducted by Dr. John Madden of STC Enterprises with the guidance, direction and assistance of a committee consisting of Messrs. Jim Earle, Tony French and Fred Veuger of the Planning Committee with the addition of Dr. Axel Meisen of U.B.C. and Richard Bryan of C.O.F.I. This report is included in complete form as the blue pages following this report.

Approach Used

The committee has requested and received input from a wide range of key people in the industry in B.C. representing the provincial and federal governments, the universities, research institutions, and companies both large and small in the interior and on the coast, representing all aspects of the forest industry and its suppliers and consultant community. It has reviewed reports already produced on this subject by others and met to develop its own assessment and recommendations during the period from September 1987 to February 1988.

The forest industry in B.C. consists of the following major elements:

- Forestry
- Wood Products
- Pulp and Paper Products
- Machinery and Equipment
- Consulting

Detailed studies and reviews are being conducted specifically in these sectors, where on-going research program committees provide advice and guidance and set priorities.

General

The Committee is aware of initiatives nationally and federally concerning the future for science and technology in the forests and forest products sector including the National Forest Policy, the Edmonton Forum on research initiated by the Canadian Council of Forest Ministers, the Science Council of Canada report and various provincial focuses on science and technology including the joint Science Council of B.C./CATA study and forum on the use of advanced technology in the forest industry.

Forestry

The Canadian Forestry Service and the Provincial Government Ministry of Forests produce regular priorities for research and development. The Science Council of B.C. developed a report on the use of biotechnology in forestry in B.C. FERIC regularly develops its research and development plans with the industry.

Wood Products

Many of the studies outlined above focus also on the need for value added products in B.C. FORINTEK has an extensive program to involve industry in regularly updating its research and development plans. The companies involved also develop their priorities for research and development.

Pulp and Paper

PAPRICAN regularly involves its members in identifying and prioritizing research and development requirements and the individual companies undertake similar reviews.

Machinery and Equipment

The advanced machinery and equipment suppliers to the B.C. forest industry have recently focused on research and development with a separate study sponsored by the Science Council of B.C. which is attached. In addition, this area is currently being addressed by DIST through a study involving the federal government and representatives of the forest industry and the equipment suppliers to the industry and known as the Forest Industry Machinery Task Force.

3. BACKGROUND INFORMATION

The B.C. Forest Industry has been and continues to be the major driving force for the provincial economy. Over 45% of the manufactured output of B.C. results from this one overall sector and applications in this sector are fuelling growth in the emerging sectors of information technology, biotechnology, new materials, and manufacturing. The most significant benefits from the forest industry which are distributed throughout the regions of the province are:

- contribution to employment, direct and indirect
- contribution to tax base
- significant export trade
- contribution to the social well being of the people of B.C.

Size of the B.C. Forest Sector

Canada is the world's leading exporter of manufactured forest products, accounting for 23% of the total value in 1984.

British Columbia is the dominant province in the Canadian forest industry. Each year, 50% of the Canadian timber harvest is from B.C. forests. Sixty percent of all lumber manufactured in Canada is produced in B.C. Twenty-nine percent of Canadian pulp is produced in B.C., 17% of Canadian paper and 81% of all Canadian plywood is produced in B.C.

The total value of products exported by B.C. forest industries in 1986 was $7 billion. Lumber (44%) and pulp and paper (45%) make up the bulk of these exports, the balance being plywood, shakes, millwork, etc.

The B.C. Forest Industry and the B.C. Economy

The forest industry dominates the B.C. economy, accounting for over 45% of manufacturing shipments in the province. In contrast, petroleum, mining and coal represent 17% and agri-food account for 13%.

B.C. Forest Industry Employment

The forest industry directly employs 78,000 British Columbians with annual wages of $2.7 billion. Including the multiplier effect, the forest industries are a source of livelihood for 234,000 B.C. workers or 20% of the province's labour force.

Contributions to Tax Base

The B.C. forest industry makes a major contribution to the taxes in B.C. through stumpage, property taxes, sales taxes and income taxes. For example in 1985, the B.C. Forest Industry paid in excess of $1 billion in taxes and stumpage to all levels of government.* Changes to the B.C. Forest Act will make this figure substantially larger in future years.

*Source: Price Waterhouse, May 1987 "The Contribution of the British Columbia Forest Industry to the Federal, Provincial and Municipal Governments."

Regional Development

The B.C. forest industry is distributed throughout the province. In many communities it provides the primary economic activity and employment base. It is the only sector of the province's economy that is evenly distributed throughout all regions of the province.

The Machinery and Systems Suppliers

The B.C. forest industry has caused an additional industry to develop, namely the machinery and systems suppliers. There are a number of highly innovative companies developing products, machinery and systems initially for the B.C. industry and then selling them on a world wide basis.

It is estimated that these companies currently employ approximately 2,800 people in the province and have annual sales of $300M, a significant proportion of which is exported.

Consultants

British Columbia has developed a world class group of forest industry consultants who compete successfully internationally and serve the B.C. industry.

This sector's employment varies significantly, dependent on the world wide economic conditions of the industry. Two thousand to twenty-five hundred people are employed servicing clients on a world wide basis.

Expenditures on R&D

The total expenditure in British Columbia on research and development is estimated to be approximately $400M which is 0.7% of the Gross Provincial Product. The national equivalent is 1.4% of Gross National Product, compared to other developed countries which spend 2.0%-3.0% of their Gross National Product on research and development. The current amount expended on R&D in the B.C. forest industry (i.e. by industry, governments, research institutions and universities) is approximately $55M, 0.55% of the gross sales from the forest industry, compared to 0.7% nationally in the forests and forest products sector.

Increasing Needs for R&D

The focus of the forest industry to date has been on the volume production of commodity products for which the 0.55% of sales spent on R&D may be appropriate. The future requires a continuing emphasis on improving productivity both in the production of raw materials and products and reducing the cost of the commodity products which will remain a significant proportion of the total production. However, technology must now also lead the way towards significantly improving the economic return of the resource, adding value to the products, and exploiting fully the unique qualities of the B.C. fibre resources.

This move to value added products and increasing economic return from the resource will require larger investments in R&D than necessary in the predominantly commodity market of previous years.

Current Initiatives Relating to R&D

The committee is aware of a number of initiatives currently under active consideration.

- The Canadian Council of Forest Ministers Task Force and report
- The Added Value Task Force in B.C.
- The Forest Industries Machinery Task Force (National)
- Various initiatives of the three universities to address educational requirements
- Consolidation of the B.C. presence of the national industry research organizations
- The Science Council of Canada recent report on the Forest Industry

4. IMPORTANT ISSUES

In order to maintain its key position as the driving force for the provincial economy, the industry must address some key factors that are emerging and that will influence its ability to stay as the 'life blood' of B.C.'s economy. These factors are being recognized throughout the B.C. industry and are being discussed in many conferences and forums, nationally and provincially.

1. Significance of the B.C. Forest Industry

   a) There is a growing world-wide demand for forest products that will provide increasing market opportunities for B.C. forest products.

   b) World-wide competition for B.C. forest products is increasing due to the growing availability of lower cost fibres and fibres with differing characteristics.

   c) Growing competition is also impacting B.C. forest producers through the substitution of non-fibre products in traditional markets.

   d) Competitors are responding quickly to customers needs, becoming more productive, and developing new and improved products through the use of science and technology. A recognition is needed in B.C. to focus more on markets and customer needs.

   e) Significant investment is now underway in the B.C. industry and will continue to be required. This investment will reflect technological improvements and innovation.

   f) No strategic plan involving the forest industry, suppliers of advanced machinery and systems, government, colleges and universities, research institutions and forest consultants has been developed regarding overall industry goals and strategies and specifically the future role of science and technology.

2. Adding Value to the Forest Products and Improving the Utilization of the Resource

a) Rapid technology changes are occurring around the world where competitors are adding value to their forest products and increasing the economic return from their forest resource. The B.C. forest industry must take the lead in further increased use of technology or it will not maintain its current world position and certainly not attain the economic growth that is possible.

b) Increased value is required from the whole process, starting with improvements to the economic return from the basic resource and continuing with added value products all along the processing line to the eventual customer. This focus on adding value will expand the economic contribution of the forest industry, increase the number and quality of jobs and expand the technology industries that support the forest sector.

c) The challenge to significantly add value to the forest sector is a long term goal and must have the long term commitment of management and guaranteed funding to be successful.

d) The B.C. forest land base is diminishing because of the growth of alternative demands. It is changing in nature and becoming more expensive relative to the forests of other nations e.g. Chile, Brazil, New Zealand and the south east of the U.S.A. Means must be found to get more fibre from less land in B.C.

e) Other sources of solid wood and fibre are becoming available to compete with traditional B.C. forests. Careful evaluation of forest resources in this province must be continued to fully utilize the available supply.

f) There has been a lack of funding for R&D in the B.C. forest industry where the focus was on harvesting prime logs and producing commodity products. Now the emphasis must add to the ongoing commodity base the increased value products, improved forest resource and improved productivity. These elements can only be advanced by the increased application of science and technology.

3. Technology Transfer, Competence and Awareness

a) As the industry moves further towards the use of science and technology to add value to its products and to improve its resource, the need for technology awareness and competence increases. There will be a growing need for scientists and

engineers to undertake research and more particularly, to be 'enthusiastic receptors' for the technology developed as it is transferred to the production facilities.

b) The B.C. forest industry, working in a world-wide market, must have a high level of technology competence to understand fully its needs for science and technology and to exchange innovations in the world-wide market. The B.C. industry will have advantages if it is the first user of competitive equipment.

4. Use of Advanced Technology

a) The forest industry must explore the advanced technologies emerging in the province to improve its competitiveness. These will include information technology, biotechnology, manufacturing, new materials, advanced machinery and supplies and chemicals.

b) Opportunities will then develop for these technology based support industries to develop into significant world competitive industries in their own right, as the forest industry consulting companies have done. This development will enable the B.C. forest industry to gradually increase its purchase of B.C. technology and reverse the current trend of declining self-sufficiency.

5. STRENGTHS TO BUILD ON

The challenge presented by the trends identified above is recognized by the B.C. industry and is currently being addressed. The industry has a sound base of achievements to build its future on and to aggressively respond to the challenge.

It has a good mixture of large integrated companies and small and medium-sized entrepreneurial organizations with sound world-wide reputations. The province has a unique timber resource which enables products to be manufactured that are sold and distributed effectively on a world-wide basis.

Significant research capability in solid wood products manufacturing and pre-competitive product development exists in the national organization FORINTEK, headquartered in B.C. The pulp and paper national research organization PAPRICAN, has a world-wide reputation and a growing B.C.presence. In addition, there are several laboratories in the private sector such as MacMillan & Bloedel Ltd., etc. In addition, informal research and development activities are undertaken in a growing number of companies. Harvesting research is conducted by FERIC and selected companies. B.C. Forest Service, Canadian Forestry Service and the private sector undertake research on forest resource management. A provincial research organization exists at B.C. Research and an infrastructure is present at colleges, universities and government research institutions to allow forest related research to be undertaken.

World-wide consulting engineering and forestry companies are headquartered in B.C. together with several innovative machinery and systems suppliers. The industry has major overseas market development programs and is successfully taking advantage of its proximity to U.S. and Pacific Rim markets.

6. A CLIMATE FOR INNOVATION

The committee views the forest industry as being ready now to enter a new phase in its development. This will require increased use of science and technology to add value to its products, to improve its productivity and to obtain increased and improved economic return from its changing forests.

The forest sector's mission is:

> **"Recognizing the changing nature and increasing cost of its timber resource and the changing needs of its world-wide customers, retain competitively priced commodity products and develop value-added products by the increasing use of innovative technology, advanced machinery and systems, consulting, training and education."**

In order to achieve this mission, the committee sees five important goals as fundamental.

7. SPECIFIC GOALS

The specific goals that need to be achieved in order to reach the overall mission are:

1. A continuation of the recognition that the forest industry is the driving force for the future of the provincial economy.

2. The addition of value to the forest products, the improvement of productivity and the improvement of management and utilization of the forest resource.

3. The improvement of technological competence and awareness throughout the industry.

4. The improvement of the transfer of technology.

5. The further increase in competitiveness of the forest industry by full utilization of advanced technology industries developed in the province.

1. Commitment to Continued Growth for the Forest Industry

The forest industry must continue to be recognized within B.C. as the driving force for the provincial economy and as an industry with an expanding future. A climate must be fostered to encourage investment and to fully utilize high technology.

ACTIONS

a) Continue the present public relations programs indicating the significance of the forest sector.

b) Establish a Council on Science and Technology in the Forest Industry comprised of representatives of the industry (CEO's, COFI etc.), government (Ministers of Forests, Economic Development, Advanced Education and Job Training and Regional Development), universities and colleges, unions, research institutions and major suppliers of advanced equipment and systems. This Council will agree on a

strategic plan for science and technology in the industry and regularly monitor progress and report on new requirements. In addition, it will advocate courses of action to the industry, to national and provincial governments, to the universities and colleges and to suppliers and will focus the interests of all those involved on the future of the industry.

c) Ensure that the industry is adequately represented in all other significant councils advising the Premier and the government.

d) Obtain overall agreement to the mission statement for the forest industry:

"Recognizing the changing nature and increasing cost of its timber resource and the changing needs of its world-wide customers, retain competitively priced commodity products and develop value-added products by the increasing use of innovative technology, advanced machinery and systems, consulting, training and education."

2. Add Value, Improve Productivity and Improve the Resource

This goal focuses on using technology to add value to the forest products so that B.C. is not only the volume leader in the world but also the value leader. These added value products will complement the continuing production of commodity products and will also develop jobs in secondary industries.

The forest resource is diminishing in quality, changing in nature and the costs of management and extraction are increasing. Research and development are needed to offset such changes and to improve the quantity, quality and cost of the fibre resource. This need is particularly evident when competition from other materials developed outside of B.C. is considered and the pressures of competing uses of the forests are increasing e.g. water, fuel, wildlife, recreation and community life.

The competition around the world from traditional forest products and from 'new' materials will require consistent improvements in the B.C. industry's 'competitive edge'. Science and technology can improve productivity and develop innovative products to meet customers needs.

ACTIONS

a) Increase the overall funding of R&D in the forest sector in B.C. from 0.55% of sales. The level of 0.55% of sales may continue to be appropriate for the commodity products, however significant increases will be required to develop value added products. Countries that are successfully competing with B.C. are spending 2.0%-2.5% on R&D. A careful assessment of needs is required in order to develop the specific target % to aim for and to develop a detailed strategic plan for the expenditure of these funds.

b) The federal government should clarify that it wishes to use tax incentives as a tool for economic expansion and should therefore attach a broad and consistent definition to R&D.

c) Provide financial incentives for all components of the forest sector to undertake R&D by tax incentives, write-offs and first user risk reduction programs.

d) Encourage cooperative research between users, suppliers and researchers by financial incentives. Encourage networking to share innovative information.

e) Investigate the provision of long term secure funding for research to buffer the ups and downs of industry cycles.

f) Continue the support for industry-wide research institutions and organizations and use their agreed lists of research priorities. FORINTEK, FERIC, PAPRICAN and the federal and provincial forestry organizations have lists of research projects developed with approximately 150 B.C. people involved. An R&D strategic plan would identify additional R&D requirements to develop new and innovative products.

g) Build the in-house research organizations of the companies to identify research needs, interact with research institutions, undertake competitive research and aid in technology transfer.

3. Improve Technological Competence and Awareness

The goal is to increase the effective use of science and technology in the forest industry and to fundamentally increase the visibility and acceptance of technology at all levels throughout the industry. An increased flow of technologically competent staff can be used by the companies and research institutions to staff the necessary increased research and development activity, but also they can staff the production facilities and act as 'enthusiastic receptors' of the transferred technology.

ACTIONS

a) More forest industry specific college and university trained graduates must be trained and absorbed by industry.

b) A Solid Wood Products course masters program is required, modelled on the very successful U.B.C. Pulp and Paper Master of Engineering Program.

c) Management, planning and marketing should be added to existing science and engineering courses.

d) Continuing education is required for those already in the industry in production and technology management positions.

e) Scholarship support for students must be increased.

f) Senior management of the forest companies must continue their emphasis on research and development by:

- focussing on technology at a senior management level in their organizations
- staffing up their technology teams to a 'critical mass'
- supporting their industry research institutions

g) Networking amongst forest industry research staffs must be encouraged.

4. Improved Transfer of Technology

It is vital that the increased research and development called for be transferred successfully into the production organizations on a timely basis. This will only be achieved if there is a major effort to involve industry throughout the R&D cycle, in the identification of projects, their completion and then their successful transfer to operations.

ACTIONS

a) Encourage participation by the users in the planning of research and development.

b) Promote cooperative research between users, researchers and suppliers.

c) Increase the numbers of trained scientists and engineers in production management positions.

d) Encourage an atmosphere of innovation throughout the companies.

e) Fund specific technology transfer programs.

f) Encourage networking to communicate positive results.

5. Increase the Competitiveness of the Forest Industry by Utilizing Advanced Technology.

The goal is to fully utilize the B.C. advanced technology community to improve the competitiveness of the B.C. forest industry. In turn, this will then foster the growth of these technology industries in B.C. so they can sell their products and services on a world-wide basis. These advanced technology industries include information technology, biotechnology, advanced materials, machinery and equipment suppliers. The advantage for the B.C. forest industry of using local suppliers is the opportunity for a technological edge, local after sales service, and participation in the development and planning of innovative products.

ACTIONS

a) Undertake a series of programs to promote interaction between the technology industries and the components of the forest industry.

b) Develop joint proposals between the advanced technology community and the forest industry for research projects.

c) Develop and if necessary, legislate financial incentives for the manufacturers of equipment and systems to undertake R&D.

d) Develop incentives for cooperative research involving users, suppliers and researchers.

e) Encourage research institutions to contract out to suppliers for specific research.

f) Improve the input of advanced technology companies to forest industry research organizations.

g) Sponsor forums for interaction between industry and its suppliers.

h) Support the recommendations of the attached report addressing specifically the development of the advanced machinery and systems support industry.

8. CONCLUSIONS

In order for the forest industry of B.C. to successfully maintain its leadership position as the 'driving force' to provide jobs and economic success, it must increase its level of research and development. In the past, it has relied on a ready source of high quality wood to produce mainly commodity products which enjoyed ever increasing demand. Now the resource is changing and becoming more expensive and it must compete with lower cost fibres and non wood products made outside B.C. Research must add further value to the forest products and improve the economic return of the available resource in order to respond to market driven demands. Through research, the B.C. Forest Industry can remain strong and can increase the value of its production to become not only a leader in the volume produced but also in the economic benefits for the province. An integral part of the increased application of R&D will be the full use of the advanced machinery, systems and consulting sectors.

Implementation

In order to implement these recommendations, the Science Council of B.C. should:

- test the viability of its recommendations within the industry
- arrange for the Forest Industry Council on Science and Technology to be formed and to agree on a mission for science and technology in the forest industry
- dedicate resources to act as the research and development coordinator for the forest industry to initially plan and monitor the implementation of the recommendations of this report and then to follow up on the continued use of science and technology in this vital sector of the B.C. economy.

EQUIPMENT SUPPLIERS
TO THE
B.C. FOREST INDUSTRIES:

CREATING A CLIMATE FOR INNOVATION

A Special Report by the Science Council of B.C.

March, 1988

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EQUIPMENT SUPPLIERS TO THE B.C. FOREST INDUSTRIES: CREATING A CLIMATE FOR INNOVATION

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ABSTRACT AND PRINCIPAL RECOMMENDATIONS

The objective of the study was:

To recommend what actions might properly be taken to encourage a healthier, long term domestic equipment and software supply industry in B.C. in particular and in Canada generally, to service the forest industry sector, both domestically and outside Canada.

The investigation was by and large conducted during the months of November - December, 1987 and January, 1988, under the general guidance of a small study group appointed by the Science Council of B.C.

The group concluded that even the most generous interpretation of the data leaves the performance of the Canadian equipment suppliers taken as a group, with substantial room for growth.

It was concluded that there are significant opportunities for British Columbia which can be realized by a co-ordinated focus on the business of supplying capital equipment and software to the forest products industry. Benefits from such a focus include improvements to the competitiveness of the forest products industry through a leadership position in the use of equipment which adds value to the wood fibre harvested, reduces manufacturing costs and/or improves safety; as well as the creation new, high quality jobs in the equipment manufacturing and software sectors.

As a result of its investigations and deliberations, the Study Group made the following major recommendations:

1. **That those responsible for funding and managing the forest research organizations give serious consideration to setting aside funds to be devoted to contracted co-operative research programs with Canadian manufacturers.**

2. **That specific actions be taken to inspire a greater interest in careers in the forest sector and to improve the effectiveness of career training. These actions include the establishment of a university campus based industry research centre for wood products and harvesting technology, greater opportunity for appropriate continuing education, and the introduction of new graduate level programs in Forest Engineering and Advanced Technology Management.**

3. That forest product companies consider appropriate means to encourage a stronger spirit of constructive invention amongst their employees. The program should apply to inventions which the company itself may wish to pursue, as well as to other inventions which relate to the industry and which appear to have a commercial potential. The major consultant companies to the industry could also benefit from such a program.

4. That the Science Council of B.C., in co-operation with the Vancouver Wood Forum and other interested organizations, sponsor an ongoing series of roundtable discussions and workshops related to the employment of new technology in the forest products industry. These discussions should be structured in such a way as to attract researchers, consultants, operating management from the forest products industry, and manufacturers.

5. That the provincial government increase its support for the Science Council of B.C.'s Assistance Grants for Applied Research (AGAR) program in the forest sciences area. This program has already proved its effectiveness as a means of facilitating the conversion of applied research into successful product development.

6. That government give serious consideration to improving tax incentives to the forest products industry to invest in its own future, and to increase the domestic market opportunities for Canadian suppliers of capital equipment.

7. That governments consider the more extensive use of refundable tax credits, as an effective way of encouraging innovation.

A NOTE TO THE READER

Not everyone will want to read the complete 34 page report plus 15 pages of appendices.

These notes are an attempt to help those who want to do more than skim the abstract and major recommendations, but less than a complete read.

Successful innovation is simply not amenable to facile description and analysis. This report is far from a complete analysis, but those responsible have tried to present a variety of industry perspectives, based on the assumption that accepted attitudes and dogma may be as important to successful innovation as sophisticated plans and programs.

The following is an abbreviated guide to the report:

1. **Introduction** - 2 pages - self explanatory.

2. **Study Objective and Methods** - 2 pages - self explanatory

3. **Reviewing the Evidence** - 2 pages, 4 figures - a brief review of available statistical data.

4. **Reactions and Opinions** - 5 pages - A summary of opinions expressed by the approximately 25 persons interviewed (in 18 sessions). These people were selectively drawn from a B.C. population of innovators, manufacturers, consultants and integrated forest product company executives.

5. **The Pursuit of Excellence** - 7 pages - A summary of interviews with the presidents of three innovative and successful B.C. manufacturers.

6. **Discussion** - 10 pages, 2 figures - A discussion of the conclusions drawn incorporating recommendations where appropriate.

7. **Why Bother?** - 1 page - Why should we try to create a climate for innovation?

8. **Principal Recommendations and Conclusions** - 2 pages

Appendix 1 - **Tables of Industry Trade Statistics** - 2 pages of tables - self explanatory.

Appendix 2 - **List of Interview Questions** - 4 pages - A list

of questions used as a guide for the interviews reported on in Sections 4 and 5.

Appendix 3 - **Excerpted Notes from the Interviews** - 9 pages
An attempt to summarize the interviews in such a way as to provide a "profile" of the opinions of the individuals interviewed.

ACRONYMS

The use of acronyms has been avoided as much as possible. However the three industry research organizations which are jointly funded by industry and government have been referred to by their commonly used "acronymic" names. These are:

PAPRICAN - The Pulp and Paper Research Institute of Canada

FORINTEK - Forintek Canada Corp.

FERIC - Forest Engineering Research Institute of Canada

EQUIPMENT SUPPLIERS TO THE B.C. FOREST INDUSTRIES: CREATING A CLIMATE FOR INNOVATION

1. INTRODUCTION

Are we in British Columbia exporting tens of thousands of good high paying jobs through lack of focus on and exploitation of our natural market advantages?

Available statistical data indicates that our ability to supply competitive capital equipment to the forest products industry leaves substantial room for growth.

Yet it is commonly argued that the existence of a large domestic market is a key factor to long term success in secondary industry. If Canadian (and B.C.) manufacturers are not competitive in one of the few fields where we have a significant domestic market on a world scale, what hope is there for a healthy domestic secondary manufacturing industry of any stripe?

In this report are to be found the results of a study whose objective was to review the relationships between our suppliers of capital equipment and the forest products industries it supplies and to make appropriate recommendations.

There is a temptation in studies of this nature to search for simple explanations and to propose simple solutions. There is no shortage of such explanations and solutions. The problem is the lack of unanimity as to what the answer should be.

Our recent history is replete with plaints, pleas and panaceas on the subject of research and innovation. In the last few decades we have swung from uncritical support of basic research as the essential foundation on which innovation is built, to a near rejection of it in favour of 'applied research'. Governments have funded large instant institutes and then sold them off almost as rapidly. We have spent years building up excellence in research in some laboratories and then condemned them to a slow death by

preventing them from hiring bright young graduates and from divesting themselves of their less productive researchers. We have invented new programs (such as scientific research tax credits), and rejected or replaced them almost as rapidly. We have decried lack of policy, and pointed fingers in almost every direction - except perhaps upwards to the heavens. Government, industry, labour, multinational conglomerates, accountants, consultants, economists, universities and the educational system in general have all been targets for blame for our poor showing.

The reams of unrationed rationale for pointing of fingers may confidently be taken as good evidence for the complexity of the problem.

We have concluded that we do indeed have a problem, or, to put it in a more positive and a more realistic light, we have a valuable opportunity. But realization of that opportunity will require careful concerted work on a number of fronts over an extended period of time. It involves improvements on our existing base and structure, not massive new programs.

And perhaps most important, it requires the exercise of leadership, and the active participation by all involved parties. Success will not be achieved by lobbying government for a few months and then retiring to enjoy the change.

While it is true, as shown in figures 5 and 6 on page 26 that both government and industry have been surprisingly niggardly when it comes to investing in our future through R&D, it seemed to us that the central problem was attitude and education. We have let our once proud leadership position in the supply of capital equipment to the forest sector slip from our grasp through some combination of inadvertence, ignorance and a blind faith in laissez faire.

An important part of the work reported herein was in the form of interviews with some key figures in the B.C. industrial community involved in the development, supply and acquisition of forest industry capital equipment. These interviews captured many of the disparate views already referred to. They also provided some helpful insights into what might be done to better the likelihood of successful innovation in B.C.

The study group has combined these insights with their own knowledge and experience to derive the recommendations to be found in Section 8.

2. STUDY OBJECTIVE AND METHODS

The formal objective of the study was:

To recommend what actions might properly be taken to encourage a healthier, long term domestic equipment and software supply industry in B.C. in particular and in Canada generally, to service the forest industry sector, both domestically and outside Canada.

The term "equipment and software supply industry to service the forest sector" is a cumbersome one which will be frequently abbreviated throughout the report. The usual shortened reference will be to "equipment suppliers" or simply "manufacturers". This abbreviation is intended to include suppliers of instrumentation, control systems or software whose function is primarily technical in nature.

The investigation was by and large conducted by John Madden, Principal, STC Enterprises, acting as a consultant to a small volunteer study group responding to an invitation from the Science Council of B.C. The group comprised the following members:

Mr. Jim Earle (Chairman), General Manager, Hardboard Division, Canadian Forest Products.

Mr. Richard C. Bryan, Manager, Economics, Statistics & Energy, Council of Forest Industries of B.C.

Mr. K. A. French, President and C.E.O., Forintek Canada Corp.

Dr. Axel Meisen, Dean of the Faculty of Applied Sciences, University of British Columbia.

Mr. Fred Veuger, President and General Manager, CAE Machinery Ltd.

The study itself comprised the following elements:

1. A limited examination and study of available statistics describing the health of the industry which supplies capital equipment to the forest industry.

2. A series of eighteen interview sessions with representative knowledgeable members of the forest products

industry, and the manufacturing and consulting industry which supports it. In addition, several fruitful discussions were held with government and university representatives.

3. An examination of the information assembled by the study group, and, after discussion, the formulation of conclusions and recommendations.

Those interviewed were presented with a list of questions at the start of the interview session (see Appendix II), but no attempt was made to insist on a rigid adherence to the questions as formulated.

The study group met on four occasions between November, 1987 and January, 1988 and provided strong guidance and support to the conduct of the study.

3. REVIEWING THE EVIDENCE

It is possible to define a "self-sufficiency index" which gives a measure of the extent to which our manufacturing industry is meeting the needs of its Canadian forest products industry customers. Unfortunately the name of the index is slightly confusing, as it could be interpreted as implying or suggesting that all equipment used in Canada should be acquired from Canadian manufacturers. This of course would be nonsensical. What the index does measure in a compact fashion is the balance between equipment exports by manufacturers and equipment imports by users.

The index is defined as Manufacturing Shipments (i.e. domestic shipments plus exports) divided by the Domestic Market (i.e. domestic shipments plus imports). If imports were to equal exports, then the index would equal one. This would be a reasonable status quo for many industries, but for an industry which supplies its own domestic world leading forest products industry, the tremendous advantage which such a situation gives it would reasonably lead to the expectation that its exports would substantially exceed imports, perhaps, if things were going very well, by a factor of as much as two or three.[1]

As can be seen from the summary chart shown in Figure 1, our total self-sufficiency has for some years hovered between 75% and 94%, but appears to have dropped precipitously to 61.5% in 1986, the last year for which figures are available. Performance differs substantially from year to year and between segments of the industry. Figures 2, 3 and 4 depict the year to year variations of the self-sufficiency index for logging machinery, woodworking and sawmilling equipment and pulp and paper machinery respectively.

It has been said that there are three categories of falsehoods - lies, damn lies and statistics. A close investigation of the reliability of oft-quoted numbers is sometimes disillusioning. The statistics quoted above are disquieting, if not alarming. Are they accurate?

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1. This paragraph is substantially reproduced from a previous Science Council of B.C. report entitled "Emerging Technologies and the B.C. Forest Products Industry: Observations and Opportunities", 1987.

The answer is a clear "more or less"!

Mr. Dick Bryan, a member of the study group for the study, and Manager, Economics, Statistics and Energy for the Council of Forest Industries of B.C. initiated a review of the available statistics, most of which are compiled by the federal government.[2]

In the course of his review, Mr. Bryan discussed the data with several officials from the federal Department of Regional and Industrial Expansion in Ottawa who had assisted in developing the tables of industry self-sufficiency data reproduced here in Appendix I. All individuals contacted expressed some concerns, particularly with the most recent data. To some extent, their concerns reflected the fact that major portions of the 1985 and 1986 data are estimates based on available data and concern about possible temporary distortion due to exchange rate realignments. There also appear to be problems in terms of improper allocation of equipment to sectors and the fact that much of the equipment used in the sawmills, for instance, is not included. Nevertheless, based on their knowledge of the industries involved, all of the individuals contacted felt that there was a significant trend toward declining self-sufficiency in these sectors.

After considering the evidence, the study group decided that, with the possible exception of the figures relating to woodworking and sawmilling, the data probably provided a reasonable indication of our overall position, although the absolute numbers quoted are probably only very approximate.

The group concluded that even the most generous interpretation of the data still leaves the performance of the Canadian equipment suppliers taken as a group, well below a satisfactory level.

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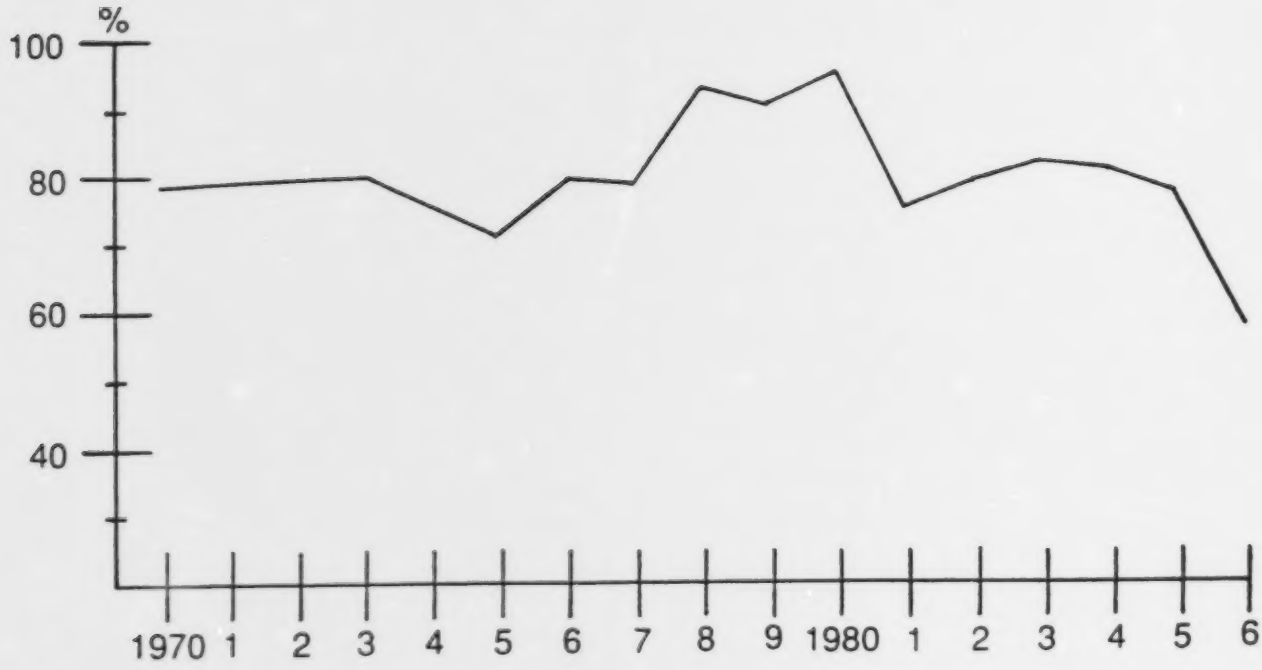
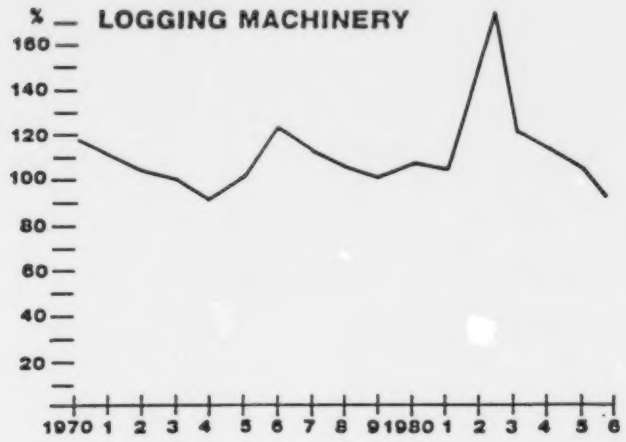
2. The review was directed and conducted by Mr. Bryan with assistance from Mr. A. Thorstensen.

TOTAL – ALL EQUIPMENT



Implicit Self–Sufficiency – Production of Forest Industry Equipmen

FIGURE 1



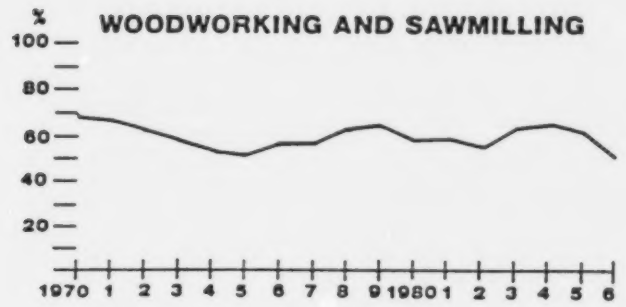


FIGURE 3

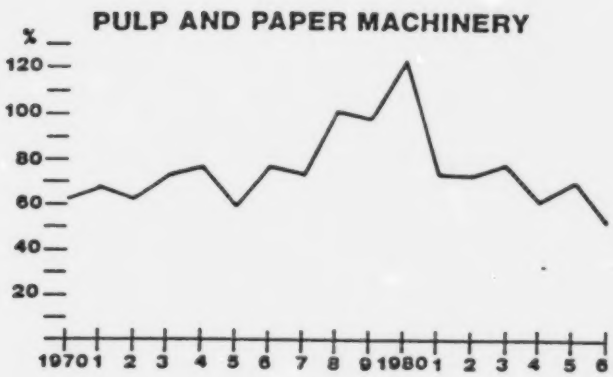


FIGURE 4

IMPLICIT SELF-SUFFICIENCY–
PRODUCTION OF FOREST INDUSTRY EQUIPMENT

4. REACTIONS AND OPINIONS

In this section the opinions expressed during the eighteen interviews with industry executives are summarized. As is to be expected, some issues drew a unanimous, or near unanimous response, others widely varying views.

Excerpts from notes of the interviews are provided in Appendix II. The excerpts have been selected with the intention of providing some feel for the range of views encountered and their provenance. They are not intended to provide a faithful record of the interview.

GENERAL IMPRESSIONS

1. Many, but by no means all, forest product industry executives and consultants felt that Canadian suppliers of capital equipment and software lagged the field competitively.

2. Forest industry executives differed considerably in their assessment of the value of buying from a local supplier.

3. Almost all of those interviewed, acknowledged the reluctance in the industry to be the first to try a new piece of equipment, and pointed out the extreme penalties in terms of lost production should key components in, for example, a pulp or newsprint mill fail. Of course the penalties for lost production are not extreme everywhere in the industry. There was evidence, for example, that it is not nearly so difficult to find a first user for new log harvesting equipment as for a paper machine or a new veneer lathe.

   The conservative attitude of many forest products company executives towards equipment purchase was a source of considerable frustration to many of the Canadian equipment suppliers interviewed. In most such instances the manufacturers pointed with pride to substantial sales in the U. S. and elsewhere, despite the slow pace of Canadian sales.

4. There was considerable confusion over the idea of a First User Risk Reduction Program aimed at assisting domestic equipment suppliers in making their first critical sale. It was thought by some that, given the high cost of lost production from breakdown of new

equipment (referred to in 2. above), it was not feasible to institute a program which would act as a significant incentive to acquire equipment. Some manufacturers saw a risk reduction program as just another way of getting support for new product development. As such, it was not clear that it was likely to be any better than existing industry support programs.

5. Interestingly, few forest industry executives believed that consultants had a significant influence on the choice of manufacturer of equipment they bought. This was in marked contrast to some suppliers, who believed that the influence of consultants was major, and was an important negative factor as far as Canadian manufacturers were concerned. There may have been some confusion in the interpretation of this question. Considered opinion seems to be that while consultants do have a major influence on equipment selection when their task is to plan and construct a new mill outside Canada, it is thought that their influence on domestic forest product companies is not strong.

6. Although it is difficult to generalize on the basis of such a small sample, consultants (each with his own list of exceptions) did not think very highly of the Canadian supplier industry.

7. Forest industry executives were unanimous in their lack of interest in acquiring equipment manufacturing subsidiaries. They were intent on "sticking to the knitting". Thus, the advantage shared by Northern Telecom (who are majority owned by Bell Canada) and by some of the Scandinavian equipment supply companies which are owned by integrated forest product companies, are not open to Canadian companies, at least in the near future.

8. Most industry executives indicated that they felt some obligation to help a valued supplier to expand his sales into other companies, possibly including competitors. It was clear, however, that enthusiasm would be much higher if the assisting forest products (FP) company received some kind of royalty or fee in recognition of its effort.

9. There were no clear signals given as to promising areas for the B.C. supplier industry to pursue, though there was general agreement that electronics and software were rapidly growing areas with important application to the field. The view was expressed on several

occasions that a focus on equipment and software for the wood products industry (particularly in remanufacturing), was likely to yield higher returns than similar effort in the pulp and paper side of forest products.

10. Most FP executives indicated that they were prepared to buy mill components and integrate them into a mill, and did not believe that suppliers of "packaged" mills, in which the supplier takes responsibility for the proper interworking of all the component parts, were a threat to small, independent firms who traditionally sell their equipment direct to mill managers and superintendents.

11. There was universal agreement on the value of conferences and round tables. Several quoted the Vancouver Wood Forum as exemplary of the genre. Others quoted the Forintek seminars and workshops.

12. Most of those interviewed had heard only vague rumours about possible federal government support for a centres of excellence program tied to the universities. Most reacted favourably to university research. Reaction to research in government laboratories, with the exception of research in forestry, pollution prevention, forest fire and disease prevention, was generally cool.

13. While most of those interviewed were in favour of university research as inherently "a good thing", most also viewed such research (except in areas pertaining to forest husbandry) as being quite remote from their requirements.

14. Patents are clearly of great importance to most manufacturers supplying the industry. Product development times for successful products seemed to be surprisingly long - ten or twelve years before really significant sales were achieved in several instances. Given the standard patent lifetime of 17 years, this left little time for a good sales return before facing directly competitive products. This circumstance was clearly an important motivator for the opinions expressed about the conservatism of our forest products industry.

15. Opinion varied considerably concerning the effectiveness of our foreign trade missions and of the Export Development Bank (consulting firms generally seemed to value EDC services more highly than manufacturers), but it was clear that restrictions imposed by the EDC have a significant and positive

effect on the Canadian content of EDC financed projects.

16. The forest products industry is remarkable for the wide range of opinions on the importance of R&D. Hank Ketchum, President and C.E.O. of West Fraser Timber expressed the view of many of his colleagues when he remarked that he saw no need for full time R&D personnel in his company. However he carried on to point out that West Fraser has been involved in development projects with equipment suppliers, in some of which the major portion of the conceptual and design work was carried out by West Fraser employees. The company keeps abreast of innovation by participating in Forintek and Feric, and by paying attention to new products made available by equipment suppliers. He believes that pursuit of this strategy has permitted West Fraser to maintain a leadership position insofar as innovation is concerned.

    MacMillan Bloedel in B.C., Domtar in Eastern Canada, and Weyerhauser in the U.S. have been notable for their concentration on R&D.[3] Dr. Otto Forgacs, the Senior Vice-President of R&D at MacMillan Bloedel was asked what the impact of this emphasis had been on corporate profitability. His answer was admirably frank.

    While noting that MacMillan Bloedel currently had the best return on investment of the west coast integrated forest products companies, he felt that good management overall probably was at least as important a factor as returns from past R&D. He did however express the view that new products and techniques emerging from his laboratories were likely soon to make the case for more R&D more visible and compelling. Of course, the emphasis of MacMillan Bloedel's development effort is on new potentially high margin products for sale to its customers, rather than on new equipment it might use. However, in recent years, the company has shown a willingness to work with suppliers and research organizations seeking to develop ways to improve the efficiency of M&B's manufacturing operations by the introduction of new equipment.

    The case for Weyerhauser's R&D is also confusing in that Weyerhauser too is a highly profitable company, but this is believed to be due in substantial measure

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[3]. Most major American integrated forest products companies are now building up their research capability in a determined manner.

to the fact that it owns outright a large percentage of its timber reserves.

In brief, it would appear that there is not yet enough firm evidence on the financial returns to an integrated forest products company in performing its own R&D to convince most of the CEO's that a significant investment in R&D is warranted. The same does not appear to be the case in the U.S., though the change is recent in origin.

It will perhaps be helpful to an understanding of this issue to draw a distinction between curiosity driven **"basic" research**, almost all of which takes place in universities and government laboratories, goal oriented **"applied" research** which may take place in universities, government laboratories and, to a lesser extent, in industry, and **development**, an activity which seeks to apply the results of applied research to commercial or operational products and processes. This latter activity predominates in commercial R&D operations. The very pace of technical development is leading commercial development laboratories to develop closer links with applied research laboratories as well as to invest more heavily in applied research themselves.

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5. THE PURSUIT OF EXCELLENCE IN B.C.

Ken Miles, the President of Kockums Cancar put it very succinctly.

"The key factors for successful innovation are - a good product champion, a good inventor, financial depth and product reliability."

The history of a number of successful innovations, as recounted to the interviewer, bears out these remarks.

Durand-Raute's Rotary Clipper

Consider the case of the development of the rotary clipper, a machine which clips veneer sheets in the plywood industry. The patent for this device is held by Durand-Raute of New Westminster, in the name of John Hards, an engineer currently employed by B.C. Forest Products Ltd.

The problem which the clipper addresses is that of cutting a sheet of veneer which is being moved along at 300-500 feet per minute in such a way that large knots are efficiently cut out.

The traditional solution employs a knife activated by a photodetector cell which senses the existence of the knot, and causes a knife to descend onto the veneer, cutting across its width twice, once on each side of the knot in question. If no out-of-specification knots are encountered, the veneer is clipped to some arbitrary maximum length (usually 54 inches). The difficulty with this technique is that the descending knife halts the speeding veneer while the cutting takes place. This frequent, jolting deceleration is hard on the equipment (and is thus an important source of unreliability), and on the veneer (causing damage and loss).

Durand were aware of the problems with the traditional clippers some fifteen years ago, and were working on an answer to the problem when John Hards walked in their door with a better solution. His idea, expressed primarily in words, but with a short accompanying sketch and description, was the genesis of the rotary clipper, essentially a rotating knife which, on command, rotates in the same direction and at the same speed as the moving veneer. The veneer is squeezed between a roller and the rotating knife at the point of clipping.

It is fortunate that Reg Tyler, the engineer with whom Hards had his first meeting in the late 1960's, recognised the idea as superior to any of the solutions that Durand were considering at the time. The all too human tendency of course is for an engineer to consider his own or his company's inventions as superior to that of any outsider.

The patent for the rotary clipper was issued in 1972. It took six years to sell the first clipper, and two ran for a year in one mill, before any additional sales were made. This despite the claim that the rotary clipper almost doubles productivity, that wood recovery is improved by 1-2%, and that operating and maintenance costs are substantially reduced.

The slow initial sales would seem to have been due in part at least to the difficulty of getting the machine to clip at the precise location demanded. This problem was solved after several years by the introduction of servo valves and computer activated control.

Up to the end of 1987, approximately 130 clippers had been sold at a unit price which is currently approximately $500K. Paul Carter, the President of Durand-Raute, estimates that there is a remaining market for about 100 more, primarily in the U.S., where a major plywood manufacturer has recently adopted them as their 'standard'. It is only in the last few years, near the end of the seventeen year patent life of the product, that sales have been really brisk.

The rotary clipper story is an interesting one for several reasons. One is the exemplary manner in which it illustrates the need for financial depth. Given its long development history, it is hard to imagine that John Hards could have used the rotary clipper idea as the starting product around which to establish his own company.

Another interesting aspect of the story is the procedure that Hards used to protect his idea before disclosing it to Durand, who subsequently paid for the expensive and lengthy patenting process. Hards simply mailed a short document describing his idea to the United States Patent and Trademark Office, accompanied by a cheque for $6 U.S. By exercising his right to file "Disclosure Documents", he was able to establish a claim to the idea, though he was obliged to act on it by filing for a patent within two years.

Once the new Canadian patent law is proclaimed, Canadian patent rights will be based on the "first to file" for a patent, rather than the "first to invent". Thus, under

the new law (the most publicized aspects of which have dealt with the pharmaceuticals industry), Hards would not have been protected in Canada had he disclosed his idea to Durand before filing for a patent.

Whatever may be the merits of the new approach (it is clearly much simpler to administer, and avoids much costly litigation), it will clearly act as a disincentive for future inventors like John Hards to discuss their ideas for new products with potential manufacturers before entering into the expensive and time consuming process of filing for a patent.

Every innovation is unique in the way it develops and grows. That is part of what makes the task of trying to encourage innovation so difficult to do well. It will be helpful, to illustrate some of the characteristics of successful innovation in the forest products sector with two more examples.

The Fibron Paper Feeding Machine

Sid Rooney, the President of Fibron, another New Westminster company, described the germination of the idea for his paper feeding machine in the following way.

Tearing of the paper being manufactured in a paper machine is a constant industry problem, and one which plays a major role in productivity. The paper sheet, which is commonly twenty feet ~~across~~, emerges from the dryer with a velocity between 30 and 60 miles an hour. Normally the paper will feed directly into the calendar, a series of steel rollers which compress the paper and impart its final surface texture. It is precisely at the input to the calendering machine that breakage is most likely to occur. When it does, the dried paper is ejected (at 30-60 MPH) into a space provided for such occasions underneath the machinery, while the operators, responding to urgent klaxon horns, rush to start a delicate process of rethreading the paper into the calender. Later on, the wasted paper generated during the crisis, is recycled. It is difficult to imagine the volume of waste paper which results from, for example, a fifteen minute period of paper breakage, without having seen it.

Given the rapid buildup of waste paper when breakage occurs, it is easy to believe that the pressure to effect a rapid rethreading of the calender is high. During one of these rethreading operations about fifteen years ago, an operator caught his arms in the calender and lost both of them.

At the time, Sid Rooney was President of a trusted supplier of machinery to the mill (i.e. Durand). The mill manager, understandably very upset by the incident, asked him to design a machine so that such an accident never happened again.

The result is the patented Fibron paper threader, a machine which first sold in 1972, and which now boasts over 400 installations around the world. Sales have recently increased substantially. With only about 10% of the world market penetrated so far, and with a one year payback on the product for a mill which suffers 3-4 paper breakages per month, Sid and his son Ken, who is the General Manager, believe that the product has about ten years of useful life left.

Sidney Rooney is a veteran innovator in the industry, a man who has much useful knowledge to impart to those wishing to follow in his footsteps. A mechanical engineer by training, he spent his early years working for B.C. Pulp and Paper Company, before being recruited by H.A. Simons to make his growing expertise available on a consulting basis. After founding another consulting company with some associates, he later became a partner and President of Durand Machinery. The technical insights and personal contacts which he made in the course of this progression must surely figure as important factors in his success.

One of the early sales of the Fibron paper threader was to a large Japanese paper manufacturer. Rooney describes how he and a few others went to Japan, installed the system and carefully trained the operators. He is now a good friend of the President of the Japanese company who loudly proclaims that Rooney is the only company president he knows who has actually worked on his factory floor!

Rooney tells a story of visiting a mill which had one of his original paper threading machines installed. He asked the mill manager how it was working, and was informed that it was "working just fine". The same question put to a variety of mill superintendents and engineers elicited a similar response. Finally he asked one of the workmen on the job, who told him that "it didn't work worth a damn!" Further investigation revealed that the threader was out of alignment. After a few hour's work, both Sid and the workman were satisfied that it really was working, and the others weren't liars any longer.

Rooney is amongst those who believe that the Canadian forest products industry is conservative and slow to take up new ideas. As partial evidence of this, he revealed that only two B.C. based forest products companies have so far

bought his threaders (one of them being the owner of the mill whose worker lost both arms), despite the fact that his equipment has sold very well abroad. At the time of his interview, he was preparing to exhibit a model of his threader at the major annual American pulp and paper manufacturer's show in Atlanta. He would like to have gone to the corresponding Canadian show too, but had been told that there was no booth space available this year, and probably not next year either!

It has been reported that the Canadian show, which is sponsored by the Canadian pulp and paper manufacturers was a great success in 1987. It has also been reported that Canadian manufacturers were notable by their absence. It is sad that the very success of the Canadian show has led to the exclusion of Canadian manufacturers.

It should be added that Rooney is philosophical about the difficulty of attending the Canadian show. He knows that over 80% of his sales are outside Canada.

The Madill Swing Yarder

Chuck Madill's grandfather started a machine shop in Nanaimo in the early part of the century. Chuck has recently passed on the day to day management of S. Madill Ltd. to his son Pat.

The swing yarder, currently Madill's most successful product, is a very large piece of mobile equipment which is used to 'yard' recently felled logs to the roadside. The large version of the swing yarder weighs 100 tons and sells for about $800K (the smaller version is about $200K cheaper). It does the work of two mobile spar trees and reduces the wage bill by the equivalent of eight people.

Madill was not the inventor of the swing yarder, nor was he its first manufacturer. He did, however, observe the high failure rate of the early machines, largely due to problems with the hydraulic transmission system. So he built a yarder with substantially greater power and a much simpler transmission system. Reliability was dramatically improved. Equipment availability went from somewhere between 70% and 80% to over 95%, and Madill's market penetration went into high gear.

Madill has intense feelings of like and respect for his customers, with many of whom he clearly has close personal, as well as business, ties. For him, university and government research is irrelevant, he gets his ideas from his customers. He is proud of the unconditional guarantee which comes with his product, and claims never to have had a

problem selling the first unit of a new product. "My customers know that if it is not satisfactory, I will fix it, or, if necessary take it back and send them a cheque", he says, adding ruefully that this latter chain of events has been known to happen.

He speaks with genuine regret of the three fine (U.S.) companies which were his competitors, but which did not survive the latest industry slump, and wryly notes the advantage he has from working in a high labour cost area. The much lower effective labour rate for loggers in the U.S., he claims, has meant that many U.S. logging companies buy second hand mobile spar pole equipment from B.C. Our relatively high labour rates have evidently forced labour saving innovations, while the higher wood costs in Europe and the U.S. have led to a greater emphasis on new products which enhance wood recovery. Necessity truly is the mother of invention.

Madill spent about $4 million developing his two sizes of swing yarder machines. The company got no help from the government, and is proud of its independence. He sells primarily in B.C. and the west coast of the United States, but he has also sold equipment to Australia and New Zealand.

It is an awesome experience to be shown the chassis of a 100 ton loader held in a giant milling machine which works to tolerances of a thousandth of an inch.

MacMillan Bloedel Research, Finning Tractor and Caterpillar are currently supporting work at U.B.C. on a complex computer controlled pressure feedback system to permit operators of heavy mechanical equipment to sense directly how much mechanical force is being applied by their equipment onto the object they are working on.

In an era of relatively inexpensive artificial intelligence and robotics-related accessories to heavy equipment, it seems likely that manufacturers of harvesting equipment will have to broaden their technology base substantially in order to remain competitive.

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Descriptions of the three products developed by three B.C. based innovative companies were included to illustrate some of the constraints and opportunities which our manufacturers face. They are not alone. There are other excellent companies in the industry in British Columbia, even though one might wish for many more.

Like good companies everywhere, they share a focus on

good management, a focus on the needs of their customers, and attention to the financial basics. All the products described were developed in response to requirements of the B.C. forest products industry, though all have found markets abroad. The product ideas came from a variety of sources, but all required dogged determination and financial depth to develop.

Suppliers to a cyclical industry typically face even worse cyclical market fluctuations. Hence financial depth and acumen would seem to be particularly important aspects of a successful operating formula. Some have achieved financial stability by becoming part of conglomerates whose activities in other spheres of the economy can carry them through severe downturns in the forest industry. Few seem to have sought that depth to any significant degree by diversification within the company. The virtues of "sticking to the knitting" seem to outweigh the benefits of spreading risk through diversification.

The evidence is increasingly clear that the traditional formula for success in the industry increasingly requires a new ingredient, namely skill in the application of the new information technologies.

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6. DISCUSSION

Innovation can be defined as the successful prosecution of an invention to the point of product or service realization. **Successful commercial innovation** of course requires that the innovator realizes a return on his investment commensurate with the risk he has undergone in its prosecution. The world is full of people with inventions. Most are not commercially competitive.

It only takes a few good basic inventions carried through to successful fruition, whether those ideas originate within or outside the company that exploits them, to have an important impact on employment and prosperity in British Columbia.

In preparing its recommendations, the study group laid particular emphasis on searching for ways in which the existing system could be improved so as to tip the balance further in favour of innovative success. The study group paid close attention to strategies which seem to have been successful in the past.

In drawing its conclusions, the study group considered potential recommendations in the following categories:

1. Encouragement of good inventors.
2. Actions aimed at encouraging forest product companies to adopt innovations more readily.
3. Actions aimed at encouraging manufacturers.
4. Recommendations relating to the educational infrastructure.
5. Action aimed at encouraging effective cooperation and information transfer between all of the above.

1. Encouragement of good inventors.

Inventors come in many shapes and forms. Worthwhile inventions are usually the result of an exceptional understanding of the customer's real requirements (whether expressed or not), coupled with a good comprehension of what is technically and economically possible to produce. It is still often the case that the fundamental idea underlying an invention is quite simple; it is the implementation which is complex. Durand's Rotary Clipper (described in Section 5) is a good example to illustrate the point.

Invention is the mainspring of success for manufacturers. Without it, they will not long survive. For the forest products companies, the economic pressures for invention do not yet appear to be nearly as strong. Yet it is the engineering and technical employees of the forest products companies who should be the best source of ideas as to what new products are needed by the forest products industry - that vital first half of the successful innovation equation.

Vertical integration, wisely managed, can be an excellent strategy for force feeding successful innovation. In such a structure the Chief Executive is in a position to force co-operation between one key (first user) customer and the manufacturer. Bell Canada has tuned this structure to a fine pitch with sensational success. Although the process is fraught with internal quarrels which are not allowed to surface publicly, telephone company employees work closely with Northern Telecom and Bell Northern Research employees first to specify needed new products, then to test them, and finally to help market them world-wide.

There is no sign that the forest products industry is interested in vertical integration of this type. In the circumstances it seems prudent to look for other mechanisms.

It has come to our attention that the province of Quebec this year held its first "CARREFOUR FORESTIERE", a conference whose purpose was to create an environment for interchange and co-operation between researchers who are working in fields relevant to the forest industry. The conference, which was attended by approximately 1500 people from industry, university, government and suppliers, was judged to be a great success. A similar conference is reputed to be under consideration in Ontario.

The study group recommends that the Science Council and/or the Discovery Foundation give serious consideration to holding such a conference in British Columbia. If only one new product such as the Durand rotary clipper, the Fibron paper feeder, or the Madill swing yarder was the result, the conference would more than pay for itself.

But that is not all that can be done. As John Hards has demonstrated, the forest products industry (and its technical consultants) can be an important source of ideas for its own improvement, ideas which are often of little interest to the employer, who would be prepared to buy such a product if produced, but who is likely to have little interest in manufacturing it. Nonetheless, the employer can play a role in encouraging innovation amongst its employees, and, particularly if it has provided financial and legal

assistance in filing for a patent, it may also benefit from a share in the royalty stream. In searching for the appropriate means to provide encouragement, it may be helpful to examine some practices which have grown up in the telecommunications industry in Canada, where it is not uncommon for an employer to provide assistance to an employee wishing to pursue an invention which the employer has decided he has insufficient interest to pursue himself.[4]

The Study Group therefore recommends that forest product companies consider appropriate means to encourage a stronger spirit of constructive invention amongst their employees. The program should apply to inventions which the company itself may wish to pursue, as well as to other inventions which relate to the industry and which appear to have a commercial potential. The Study Group felt that the major consultant companies to the industry could also benefit from such a program.

The Science Council should be prepared to provide advice and assistance on request to any companies wishing to establish such a program.

2. Encouraging Innovation by Forest Products Companies.

With a few notable exceptions, there seems to be a general consensus among forest product company executives, manufacturers and consultants that B.C. forest products companies tend to be more conservative than their competitors elsewhere.

Prominent among suggested remedies for the implied over conservative approach to innovation were tax incentives.

It was pointed out by several of those interviewed that the ability of Scandinavian forest product companies to

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4. Because the new Canadian patent law legislates an approach with respect to patent protection which requires the establishment of first patent application rather than first registration of the invention (as is still the practice in the U.S.), the barriers to the successful pursuit of inventions by individuals such as John Hards, the inventor of the rotary clipper (see pp. 14-16) are even higher. Such people may now feel driven to file for their own patents, a course which may be beyond their financial means, or to found their own companies, a course which, in many if not most cases, will be beyond both their financial means and their managerial competence.

write off their investments in new equipment as rapidly as they choose, provides a very real incentive to those companies to upgrade their mills, and fosters a much more innovative approach.

In an era when governments in Canada and elsewhere are desperately endeavouring to simplify their tax systems and reduce the number of special cases, the committee is cognisant of the fact that recommendations for changes to the tax system are unlikely to find favour with the federal Department of Finance. They nonetheless **recommend that government give serious consideration to improving tax incentives to industry to invest in its own future, and to increase the domestic market opportunities for Canadian suppliers of capital equipment.**

Many of those interviewed remarked on the high penalty, in career terms, exacted on those employees of forest products companies who promote an innovation that fails. Forest product companies would do well to review their de facto practices in this respect. The implementation of a seriously promoted invention recognition program as discussed above - under incentives for inventors could do much to help in fostering a positive attitude towards innovation.

3. Incentives to Encourage Innovation by Equipment Manufacturers.

When considering any kind of subsidy program, it can be useful to start with a general principle that, insofar as possible, the program will be structured so that organizations will contribute roughly in proportion to the benefits expected.

The rationale for any form of government involvement in subsidies to a commercial enterprise is usually based on two key assumptions, i.e. that the project being subsidized would not proceed without government subsidy, and that the net return to the taxpayer will exceed (at least on average), the taxpayer's contribution to the company. Unfortunately, the first assumption is difficult to prove at the best of times, while the second can only be calculated with the wisdom of hindsight.

These complications mean that R&D support programs are difficult to handle at the best of times, and there is a long history of projects which exemplify the worst of times.

Unfortunately our manufacturing industry is faced with competitors from other countries who receive substantial subsidies. The subsidies come in many shapes and forms. In

the U.S., the subsidies often take the form of defense contracts, in Japan, they are often government subsidized joint R&D laboratories. In Canada, as can be seen from figures 5 & 6, neither industry nor our governments have much to be proud of in terms of expenditures on R&D as compared to our major international competitors. Rightly or wrongly, other nations have seen substantially more common advantage in industry subsidies than we have in Canada. This makes it difficult for Canadian industry to be competitive, particularly for developments requiring a large capital expenditure and a high risk.

In advocating the expenditure of public monies for the promotion of the manufacturing industry, the study group does so in full knowledge of the difficulties which accompany any subsidy program to industry. However, it believes that the careful application of tested techniques and programs will yield substantial dividends for the tax payer.

There is no typical manufacturing company, nor is there a typical innovator. The correct level and structure for assistance for a large company contemplating a multimillion dollar development program is unlikely to be the same as for an inventor of a new measuring instrument struggling to get a patent and set up a company.

Governments have experimented with a variety of financial assistance measures over the years, all aimed at lowering the height of the financial hurdle which must be surmounted for success to be achieved.

After careful consideration, the study group is recommending three methods of providing direct assistance to the manufacturing industry. These are:

1) Direct contracts with industry for specified development tasks which might otherwise have been performed by a forest research laboratory.

2) Augmenting of the already proven Assistance Grants for Applied Research (AGAR) program managed by the Science Council of B.C., and

3) Employment of carefully calibrated and monitored tax incentives.

INDUSTRY-FUNDED R&D AS A % OF GDP

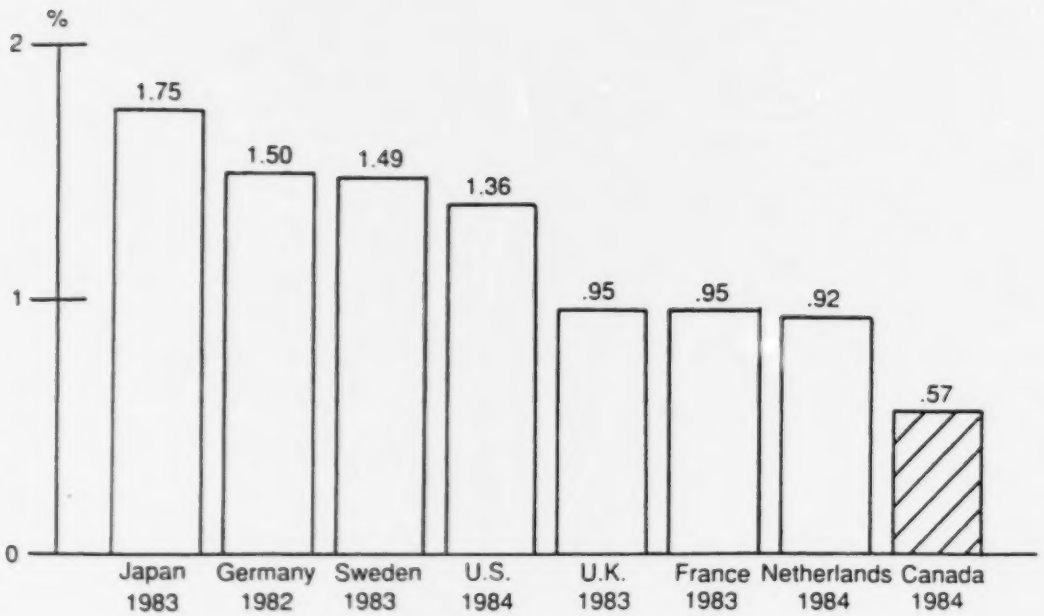

FIGURE 5

Source: OECD, Recent Results, 1979- 86; OECD, Main Economic Indicators, March 1986

TAX AND NON-TAX GOVERNMENT SUPPORT FOR R & D PERFORMED IN INDUSTRY AS A PERCENT OF GDP

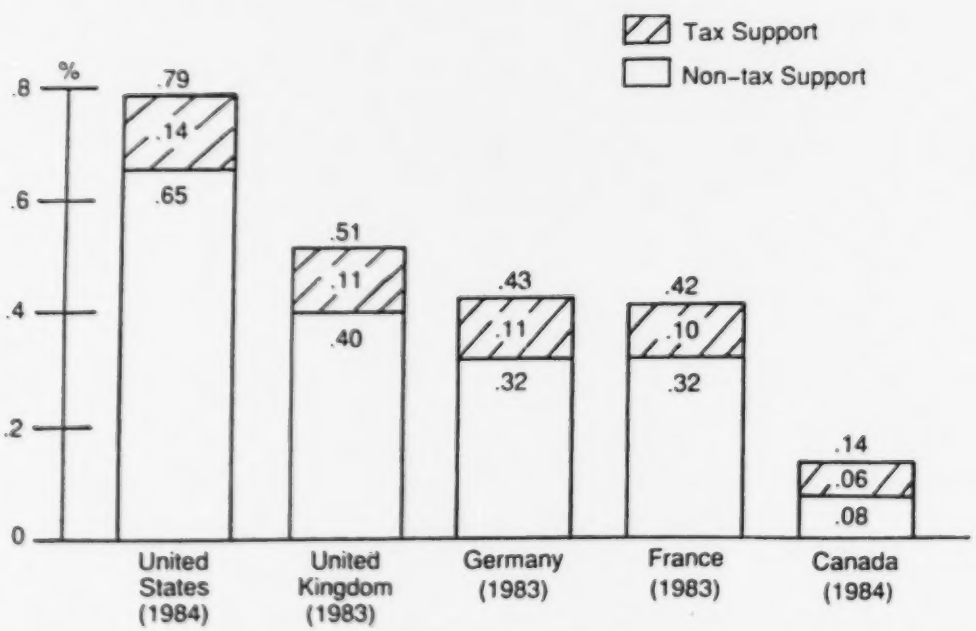

FIGURE 6

Source: Canada Consulting Group/Telesis analysis based on CMA February 1986 Discussion Paper and OECD data

1) Contracted R&D

When Lew Hatton a scientist (and a U.B.C. graduate) at the Communications Research Centre in Ottawa took the unusual step of hiring a firm of management consultants to tell him what applications of radio technology had a promising future market and were amenable to entry by a Canadian firm, he did not know that the answer was going to come back as "data transmission from a mobile radio, primarily for application to police and fire protection organizations". And when he followed up on this result (in the mid-1970's) and called for bids by Canadian companies for the development of such a radio, he did not know that after many travails a new, highly successful company called MDI would emerge in Richmond, B.C. When Hatton skillfully followed this course, he was simply following established federal government policy on "contracting out" of research which might otherwise be done in a government laboratory.

The odds of Lew Hatton's strategy for getting Canadian industry into a new field were probably substantially less than 50%, but he knew that the payoff for success could be high. He was correct. The number of employees at MDI has grown from 42 in 1982 to 339 in 1986. In the same period, net income rose from $424,000 to almost $3 million, still small by forest sector standards, but the company continues to grow at a healthy rate.[5]

It appears to be a commonly held opinion that there are a number of commercially exploitable inventions in our forest sector research organizations (i.e. Feric, Forintek and Paprican) in particular, and perhaps elsewhere as well, which are languishing due to a lack of the ability to interest an appropriate manufacturer. This is a serious problem since, with their active direction by the forest products industry, these organizations are particularly well placed to understand the important technical problems the industry faces.

But this is not a new problem. As has already been

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5. The profit figures quoted are before extraordinary items. Profit including extraordinary items was well over $3 million in 1986.

Of course, the origin of the idea for the product is only a small part of the story. Much of MDI's success is due to a brilliant initial design by Dan Gelbart, and a superb follow through by company president Barclay Isherwood and his associates.

intimated, federal government laboratories encountered it some time ago, and developed a system of contracting R&D to a company which has the capability of commercializing any appropriate discoveries.

The principal difficulty of a contracted research program is that the real expertise to do the research often resides in the contracting laboratory rather than with the contracted company. It is frustrating for the laboratory personnel in such circumstances to have to coach the company employees to do their job. The obvious advantage is that at the end of the process the company is well stocked both with the required knowledge as well as the necessary internal advocates to continue with the difficult task of converting a laboratory prototype into a viable commercial product.

The Study Group therefore strongly recommends that those responsible for funding and managing the forest research organizations give serious consideration to setting aside funds to be devoted to contracted co-operative research programs with Canadian manufacturers.

2) The Science Council of B.C.'s AGAR Program

The study group noted that the B.C. Science Council's Assistance Grants for Applied Research (AGAR) program of R&D support, adjudicated as it is by a council with research, marketing and management expertise, has proven to be an effective tool for encouraging innovation and helping to build strong linkages between university based applied research and industrial development, and should be strongly supported.

The Study Group recommends that the provincial government augment its support for the Science Council's AGAR program in the forest sciences area.

3) Tax Incentives for R&D

Blatant abuse of the Scientific Research Tax Credit program has led to an understandable reluctance by federal authorities to consider tax relief measures as a means of encouraging R&D. Nonetheless, their basic simplicity, leaves them a popular favourite with legitimate, innovative companies. For such programs to be viable it will be necessary to develop a mutually acceptable definition of research and development (particularly development), which, as we all now know, is no mean task. It will also be necessary to be able to forecast within reasonable bounds the amount of foregone revenue which the government gives up in any given year on account of such programs.

As is well known, tax credits are effective instruments for encouraging R&D in profitable companies which have a high marginal tax rate. However start-up companies in particular, frequently suffer several years of losses before establishing a successful product line. Yet these companies are frequently the ones which most need R&D assistance. The solution of making tax credits refundable to non-tax paying companies is one which is currently being used by the federal government, and one which could be further explored by both levels of government.

The committee is confident that industry is more than ready to work with governments to develop viable tax based R&D incentive programs, and forcefully adds its voice to the chorus of those **recommending the use of refundable tax credits, as an effective way of encouraging innovation.**

The Study Group noted, on the basis of remarks made during the interviews as well as on other occasions, that Canadian manufacturers could help themselves by 1) focusing more marketing effort on the consultants who assist and advise forest products companies both in Canada and abroad, and 2) giving their domestic customers the same kind of attention that they give their foreign customers.

As noted in the body of the report, the group was frequently reminded not just of the need for R&D support, but of the need for marketing support as well.

On the marketing side, the Federal Government PEMD program elicited generally favourable comments, and it is the group's view that this program too should be strongly supported.

The activities of the Export Development Corporation received a spectrum of comments ranging from strongly favourable to unprintable. In light of this situation, the corporation would be well advised to review its programs in the forest products area.

4. Recommendations relating to the Educational Infrastructure

The introduction of new technology into the forest industry is critically dependent on people. Technical experts are needed to conceive and develop prototypes, where their work is typically performed in a research and development laboratory which is either located in a company,

industrial research organization or a university. However, equally important, experts are required to incorporate new technology into commercial manufacturing operations.

In general, Canada and British Columbia are lacking both types of experts. Although there are substantial numbers of research scientists and engineers, relatively few have expertise directly relevant to the forest industry. This is largely due to the fact that the forest industry has not projected a challenging working environment, and most of the brightest young men and women have therefore opted for careers in other industries. The situation is compounded because the forest industry provides very little research and scholarship support to students. If the number of researchers with forest industry expertise is small, there are even fewer experts in production and manufacturing who are knowledgeable in research, and who have the ability to adapt prototypes for commercial use. Consequently, it is not surprising that other countries (notably Germany and Japan), which have experts of both kinds, are more successful in translating fundamental research into commercial products and processes.

Notable exceptions to the relatively bleak educational scene in Canada are the course-Master's and research programs in Pulp and Paper Engineering which were recently introduced by U.B.C., McGill University and Ecole Polytechnique, with strong financial support from PAPRICAN. The graduates, although still very small in number, have found excellent acceptance by industry due to the direct relevance of their education and training.

Consequently, the following initiatives are recommended:

1. **Strengthen collaboration between researchers (particularly graduate students in the universities) and industry through the provision of research funds for forest industry projects. PAPRICAN has already taken the initiative in the pulp and paper area, but similar efforts are needed in the forest machinery sector.**

2. **Provide continuing education opportunities for people in industry so that they can become more familiar with advanced technology. The opportunities could take the form of seminars, workshops, and short courses, as well as regular graduate-level courses, and they could be offered by representatives from industry as well as the universities.**

3. Give consideration to the introduction of new, graduate level programs in Forest Engineering and Advanced Technology Management such as are currently being developed at U.B.C. Both programs are intended to impart competencies in advanced technology and management to students with prior industrial experience. Such programs should also emphasize entrepreneurship and innovation as suggested in a recent Science Council of Canada report.6

5. Action aimed at encouraging co-operation.

There was clear evidence, both from the interviews and from general observation, of the need for better co-operative mechanisms in the industry. As one consultant noted in commenting on our performance abroad, "We play by the rules, the French play games, the Japanese do business", and, in the same vein, "When the Japanese decide they want a contract, they all co-operate to ensure they get it."

In a study of Swedish technology policies related to mine and forest exploitation[7], Anders Sandberg strongly suggests that one of the keys to Sweden's overall success is the existence of close ties between all parties involved, including government, industry (both forest products and manufacturing), environmentalist, and researchers. In Sandberg's view, we lack such ties, and our performance suffers for it.

Whatever may be the reality of the Swedish system, the study group is convinced of the need for better co-ordination and planning in British Columbia, and has the following specific recommendations to make:

That the Science Council of B.C., in co-operation with the Vancouver Wood Forum and other interested organizations, sponsor an ongoing series of roundtable discussions and workshops related to the employment of new technology in the forest products industry. These discussions should be structured in such a way as to attract researchers,

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6. Clarke, Thomas E. and Reavley, Jean, Educating Technological Innovators and Technical Entrepreneurs at Canadian Universities, Science Council of Canada, Ottawa, 1987, 102 pp.

7. Sandberg, L. Anders, A Study of Swedish Technology Policies Promoting Development of Industries Linked to Mine and Forest Exploitation, Ministry of State for Science and Technology, Ottawa, 1986, 98 pp.

consultants, operating management from the forest products industry, and manufacturers.

The committee commented favourably on the co-operation engendered by the Science Council of B.C.'s AGAR program, and noted too the positive effect that other programs and agencies, such as the B.C. Advanced Systems Institute and the Canadian Institute for Advanced Research are having, particularly in bringing university researchers closer to real problems encountered by the forest products industry.

7. WHY BOTHER?

There are several good reasons why the relatively weak state of our supply industry should be taken seriously by the community in which it lives and which it serves. These include the inherent value of the jobs created or maintained in the process, the positive effect on the forest products industry of having nearby access to expertise which can help it to stay competitive, and the positive effects that a healthy industry supplying the forest sector can itself have on spin-offs into other new sectors requiring the provision of modern equipment and software.

With annual manufacturing equipment purchases estimated at $1,133 M in 1986, the forest products industry can be a major instrument for the development of a profitable secondary manufacturing base. What is true for Canada is particularly true for British Columbia, where, in wood products in particular, we are world-leading exporters.

Of course, we have not failed totally in this endeavour. We still have in B.C. some world beating manufacturers . . . but not nearly enough of them. There is good evidence, both from the experience of some countries with which we compete, and from the success of isolated examples of co-operation, talented endeavour and timely assistance, that focus on an objective of improving the situation can have very positive results.

The challenge of improving our performance in the supply of world class competitive equipment and software for the forest products sector is indeed worthy of our attention. The returns on our investment of time and capital could be phenomenal.

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8. PRINCIPAL RECOMMENDATIONS AND CONCLUSIONS

The study group concluded that there are significant opportunities for British Columbia which can be realized by a co-ordinated focus on the business of supplying capital equipment and software to the forest products industry.

As a result of its investigations and deliberations, the Study Group recommends[8]:

1. That those responsible for funding and managing the forest research organizations give serious consideration to setting aside funds to be devoted to contracted co-operative research programs with Canadian manufacturers.

2. That specific actions be taken to inspire a greater interest in careers in the forest sector and to improve the effectiveness of career training. These actions include the establishment of a university campus based industry research centre for wood products and harvesting technology, greater opportunity for appropriate continuing education, and the introduction of new graduate level programs in Forest Engineering and Advanced Technology Management.

3. That forest product companies consider appropriate means to encourage a stronger spirit of constructive invention amongst their employees. The program should apply to inventions which the company itself may wish to pursue, as well as to other inventions which relate to the industry and which appear to have a commercial potential. The major consultant companies to the industry could also benefit from such a program.

4. That the Science Council of B.C., in co-operation with the Vancouver Wood Forum and other interested organizations, sponsor an ongoing series of roundtable discussions and workshops related to the employment of new technology in the forest products industry. These discussions should be structured in such a way as to attract researchers, consultants, operating management from the forest products industry, and manufacturers.

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[8]. A number of lesser recommendations will be found in Section 7.

5. That the provincial government increase its support for the Science Council of B.C.'s Assistance Grants for Applied Research (AGAR) program in the forest sciences area. This program has already proved its effectiveness as a means of facilitating the conversion of applied research into successful product development.

6. That government give serious consideration to improving tax incentives to the forest products industry to invest in its own future, and to increase the domestic market opportunities for Canadian suppliers of capital equipment.

7. That governments consider the more extensive use of refundable tax credits, as an effective way of encouraging innovation.

APPENDIX I - FOREST INDUSTRY TRADE STATISTICS

TOTAL - ALL EQUIPMENT

Millions Current Dollars

Year	Shipments	Exports	Domestic Shipments	Imports	Domestic Market	Implicit Self-Sufficiency
1970	176.3	54.9	121.4	105.8	227.2	77.6
1971	160.6	46.5	114.1	87.3	201.4	79.7
1972	166.0	65.2	100.8	108.0	208.8	79.5
1973	225.1	84.8	140.3	142.4	282.7	79.6
1974	279.7	114.8	164.9	207.6	372.5	75.1
1975	265.1	98.4	166.7	206.0	372.7	71.1
1976	247.8	118.1	129.7	178.5	308.2	80.4
1977	289.7	142.6	147.1	216.0	363.1	79.8
1978	389.1	224.9	164.2	267.7	431.9	90.1
1979	540.2	286.3	253.9	357.3	611.2	88.4
1980	610.4	359.9	250.5	392.6	643.1	94.9
1981	695.3	205.6	489.7	434.5	924.2	75.2
1982	486.9	194.9	292.0	331.9	623.9	78.0
1983	554.8	213.5	341.3	320.5	661.8	83.8
1984	634.3	319.7	314.6	476.8	791.4	80.1
1985	657.2	402.2	255.0	601.1	866.1	77.0
1986	697.2	299.3	397.9	735.0	1,132.9	61.5

TABLE I

LOGGING MACHINERY

Millions Current Dollars

Year	Shipments	Exports	Domestic Shipments	Imports	Domestic Market	Implicit Self-Sufficiency
1970	70.4	32.6	37.8	21.8	59.6	118.1
1971	68.6	28.6	40.0	21.6	61.6	111.4
1972	84.7	39.9	44.8	35.8	80.6	105.1
1973	118.7	53.3	65.4	52.8	118.2	100.4
1974	126.2	62.8	63.4	74.8	138.2	91.3
1975	82.0	48.4	33.6	47.9	81.5	100.6
1976	84.8	68.6	16.2	52.7	68.9	123.1
1977	126.4	76.9	49.5	62.1	111.6	113.3
1978	168.4	103.6	64.8	94.1	158.9	106.0
1979	228.9	114.6	114.3	112.7	227.0	100.8
1980	204.9	112.1	92.8	99.5	192.3	106.6
1981	151.4	72.7	78.7	65.7	144.4	104.8
1982	95.8	68.6	27.2	27.8	55.0	174.2
1983	187.9	114.2	73.7	79.8	153.5	122.4
1984	300.9	174.7	126.2	137.2	263.4	114.2
1985	240.0	120.9	119.1	109.5	228.6	105.0
1986	260.0	116.2	143.8	135.3	279.1	93.2

TABLE II

WOODWORKING AND SAWMILL MACHINERY

Millions Current Dollars

Year	Shipments	Exports	Domestic Shipments	Imports	Domestic Market	Implicit Self-Sufficiency
1970	27.1	8.1	19.0	21.3	40.3	67.2
1971	26.0	5.6	20.4	19.3	39.7	65.5
1972	34.1	8.1	26.0	27.7	53.7	63.5
1973	48.5	13.4	35.1	49.2	84.3	57.5
1974	61.2	18.3	42.9	69.7	112.6	54.4
1975	56.6	17.8	38.8	70.2	109.0	51.9
1976	54.4	13.2	41.2	55.6	96.8	56.2
1977	69.9	17.5	52.4	73.3	125.7	55.6
1978	87.9	37.1	50.8	89.0	139.8	62.9
1979	129.4	53.6	75.8	124.9	200.7	64.5
1980	125.8	34.5	91.3	131.2	222.5	55.5
1981	117.1	38.1	79.0	124.5	203.5	57.5
1982	88.0	34.7	53.3	106.0	159.3	55.2
1983	122.6	31.1	91.5	100.8	192.3	63.8
1984	144.5	69.7	74.8	149.3	224.1	64.5
1985	140.0	62.8	77.2	151.8	229.0	61.1
1986	135.0	59.3	75.7	194.3	270.0	50.0

TABLE III

PULP AND PAPER INDUSTRY MACHINERY

Millions Current Dollars

Year	Shipments	Exports	Domestic Shipments	Imports	Domestic Market	Implicit Self-Sufficiency
1970	78.8	14.2	64.6	62.7	127.3	61.9
1971	66.0	12.3	53.7	46.4	100.1	65.9
1972	47.2	17.2	30.0	44.5	74.5	63.4
1973	57.9	18.1	39.8	40.4	80.2	72.2
1974	92.3	33.7	58.6	63.1	121.7	75.8
1975	126.5	32.2	94.3	87.9	182.2	69.4
1976	108.6	36.3	72.3	70.2	142.5	76.2
1977	93.4	48.2	45.2	80.6	125.8	74.2
1978	132.8	84.2	48.6	84.6	133.2	99.7
1979	181.9	118.1	63.8	119.7	183.5	99.1
1980	279.7	213.3	66.4	161.9	228.3	122.5
1981	426.8	94.8	332.0	244.3	576.3	74.1
1982	303.1	91.6	211.5	198.1	409.6	74.0
1983	244.3	68.2	176.1	139.9	316.0	77.3
1984	188.9	75.3	113.6	190.3	303.9	62.2
1985	287.2	218.5	68.7	339.8	408.5	70.3
1986	302.2	123.8	178.4	405.4	583.8	51.8

TABLE IV

APPENDIX II- LIST OF INTERVIEW QUESTIONS

Forest Products Companies

1. What, in your view, constitutes a "good supplier"?
2. Why do Canadian suppliers seem to lag the field overall?
3. What about the 'race to be second'. Will this sentiment continue? What might change it? Could a "First User Risk Reduction Program help? If so, what would such a program do in your view?
4. What, if any, are the perceived advantages of having a local supplier?
5. What is the role of consultants in selecting equipment? Do they influence the choice as between domestic and foreign suppliers? Should they? Would you still use them if they worked with a supplier to develop a specific product?
6. Are there circumstances in which you would be prepared to help a local supplier to sell his product to your competitors?
7. Have you ever considered vertical integration? What, in your view, are the principal factors pro and con?
8. What areas seem to you to be the most promising opportunities for B.C. industry? Why?
9. To what degree are you prepared to be a system integrator?
10. Do you forecast substantial growth in the use of electronics and automation? Where? How does this affect your willingness to be a system integrator?
11. Do you think that conferences and round tables can help the dialogue between researchers, equipment developers and users? If so, what sort of a format would be most appropriate?

12. What actions could be taken to increase the probability of successful innovation in the forest sector?

13. To what degree do you feel attracted by 'total service' suppliers like Sund? To what extent does this development constitute a threat for local suppliers?

14. Do you perceive any important, constructive role for university research? government research? If so, is there anything which should be done to encourage a closer liaison?

15. Are you aware of the federal government's "Centres of Excellence" concept? Do you think this is a constructive move? If so, how should it be implemented? Would you participate and contribute? Under what conditions?

Manufacturers

1. What is your most successful product? How did it come about? What were the critical factors to its success?

2. What actions could be taken to increase the probability of successful innovation in the forest sector?

3. What is the role of consultants in selecting equipment for your customers? Do they influence the choice as between domestic and foreign suppliers? Should they?

4. Why do Canadian suppliers seem to lag the field overall?

5. What about the 'race to be second'. Will this sentiment continue? What might change it? Could a "First User Risk Reduction Program help? If so, what would such a program do in your view?

6. To what degree do you feel threatened by 'total service' suppliers like Sund? To what extent does this development constitute an opportunity?

7. Do you perceive any important, constructive role for university research? government research? If so, is there anything which should be done to encourage a closer liaison?

8. Are you aware of the federal government's "Centres of Excellence" concept? Do you think this is a constructive move? If so, how should it be implemented? Would you participate and contribute? Under what conditions?

9. How much R&D do you do currently?

10. Do you make much use of government programs? Are they helpful? How could they be improved? Which are the best?

Consultants

1. Why is the B.C. and Canadian supplier industry relatively weak?

2. Where are we good, and why?

3. Where are we bad, and why?

4. Where are the best new product opportunities for the future? Can companies producing such products rely on a domestic market?

5. How should we best go about capitalizing on those opportunities?

6. What if any role could/should the consulting industry play here? overseas?

7. To what degree do you feel threatened by 'total service' suppliers like Sund? To what extent does this development constitute an opportunity?

8. Do you perceive any important, constructive role for university research? government research? If so, is there anything which should be done to encourage a closer liaison?

9. Are you aware of the federal government's "Centres of Excellence" concept? Do you think this is a constructive move? If so, how should it be implemented? Would you participate and contribute? Under what conditions?

APPENDIX III - EXCERPTED NOTES FROM THE INTERVIEWS

It is hoped that the ensuing extracts from interview notes will serve to give a flavour for the range of opinions held by those interviewed. They are not intended to, nor do they, provide a factual summary of the interviews. The writer is grateful to the interviewees for the time and courtesy extended to him.

Senior Engineering Manager - Integrated Forest Products Company

- "Canadians don't want to get out and compete."
- "Off-shore suppliers follow up better than Canadians."
- good opportunities in environmental equipment.
- don't use consultants much.
- would be pleased to help good supplier make other sales.
- do own system integration.
- like conferences and round tables. Need broader range of topics
- "DRIE doesn't work."
- Government research a problem.
- "The old Forintek was a retirement home."
- university expertise should be tapped better.
- likes idea of Centre of Excellence.
- prov. gov't. not doing its job of long range planning.

General Manager, Purchasing - Integrated Forest Products Company

- do own systems integration.
- conferences and round tables a good idea.

- innovative focus should be on finger jointing, waste re-use and distributed process control for pulp mills.

- Canadian suppliers (with exceptions) are risk aversive and lag the marketplace.

- there is still lots of room for small suppliers.

- the Cdn. FP industry more conservative than the U.S. industry, especially in sawmills.

- any viable first user risk reduction program would have to be tied to production losses.

- consultants important in pulping, unimportant in logging. Sawmills are in between.

Consultant specializing in sawmills

- Cost of getting patents should be allowable as an R&D cost.

- Crying need for better industry planning and co-ordination.

- Concerned about membership restrictions in Forintek.

- Concerned about duplication of equipment in university and gov't supported labs like Forintek, Paprican.

- Canada is very weak in reman and specialty mfg. equipment.

- Some consultants do work with manufacturers, but most do not.

- University research should be more practical, Oregon State a good example.

- INDUSTRY TOO FRAGMENTED, BETTER CO-ORDINATION NEEDED.

President of Manufacturing Company

- compete on technology, not cost. Exports 60-80%

- patents are very important.

- Cdn. tax structure incompatible with mfg. based economy.

- Cdn. customers very conservative - it took 6 years to sell first machine (of successful line), two ran for a year in one mill, before the next ones were sold.

- Need faster capital equipment and R&D tax write-offs.

- LOW COST FINANCING IMPORTANT. FINNS USE TAX FREE DEBENTURES.

- likes first user risk reduction idea.

- yes to Centres of Excellence/No to Federal R&D assistance.

- E.D.C. are useless.

- people want to buy systems now, not machinery.

- At one time, 90% of business dealings were with customer, now have to deal with consultants about 50% of the time.

President of major international consulting firm

- Can't sell a consulting project abroad without financing.

- E.D.C. by and large responsive and receptive.

- E.D.C. financing forces Canadian content.

- Complexity of the tax system is a major business overhead.

- Cdn. consultants are more neutral than foreign competitors, they pick up business because of neutrality.

- North American industry may be less innovative because more production oriented.

- not a fan of centres of excellence. Should support existing excellence.

President of Manufacturing Company

- Patents are important.

- Key factors for successful innovation - product champion, good innovator, financial depth, reliability.

- Cdns. poor at servicing and pampering customer - possible exception is foreign customer.

- High stumpage rates help force innovation.
- Consultants are faddish. Smaller consultants do push Cdn. products.
- Need more industry co-ordination and planning.
- likes first user risk reduction program.
- has had bad experience with N.R.C. & Forintek.

Group Vice-President, Integrated Forest Products Company

- "Our suppliers won't stand up and be counted when the chips are down."
- "The Swedes seem to be more innovative. Is it cultural?"
- Our suppliers are very conservative.
- INDUSTRY DOES NOT NEED MORE ENGINEERS! IT NEEDS MORE RISK TAKERS!
- Likes idea of first user risk reduction program.
- Likes idea of contracting out for Forintek/Paprican/Feric.
- Manufacturers should do better selling job on consultants.
- Promising product opportunities? Forintek has a list of 56 items.
- Likes conferences and round tables.
- Prefers university to gov't research.
- His company does no research.
- Few mfg. cos. have people working for them who have run a sawmill. They need better market research (e.g. Link mill)

Vice-President, Engineering Services and Director of Corporate Purchasing - Integrated Forest Products Company

- 4 1/2 % financing available on Voigth (German/Brazilian) paper machine.

- likes first user risk reduction program.

- no great advantage to having a local supplier.

- Are good technical schools a factor? Quebec seems to score higher in this respect than B.C.

- CAE could mfg. a Linck type mill. It should do so.

- likes round tables and seminars.

- consultants play only a minor role. Suspicious of consultants with equipment tie-in.

- are own system integrators, sometimes use consultants.

- Don't like Sunds packaged mill approach. Need near perfect specs.

- Gov't research not very productive.

President - Integrated Forest Products Company

- thinks Cdn. sawmill mfgs. are the leaders. Especially likes Kockums, Finning, Quesnel Machinery. Well over 75% of sawmill equipment he uses is Canadian.

- Likes Forintek seminars.

- Dislikes approach of buying a packaged mill from one manufacturer.

- Forintek should be totally privately funded, doesn't like gov't R&D, not Paprican member.

- His company is highly innovative without spending funds on R&D.

- Likes idea of Centres of Excellence.

Two Senior Consultants - International Consulting Company

- Canada is losing its capability in casting and heavy machinery.

- Our training for industry is poor.

- Vertical integration a factor in the success of Scandinavia.

- E.D.C. damn good generally, Dept. of Finance naive.
- "We play by the rules, the French play games, the Japanese do business!"
- Important role for universities in research, e.g. black liquor system from B.C. Research.
- Centres of Excellence o.k. Would have to be closely tied to industry.
- NEED DEAL MAKERS, MARRIAGE BROKERS FOR INNOVATIVE PRODUCTS.
- Need same for foreign deals. When the Japanese want a contract, they all co-operate to ensure they get it.
- Universities need to be careful not to compete with private sector, e.g. Fraser River model.

General Manager of a large modern sawmill

- A good supplier understands his customer's customers.
- Not sure that Cdn. mfg. lags the the field.
- Financing not a major factor in equipment choice.
- Likes first user risk reduction idea.
- Very much prefers local suppliers.
- Consultants have little influence - used for second opinion.
- New product opportunities in reman, drying and prod'n planning.
- Prefers not to be a system integrator.
- Likes round tables (e.g. Vancouver Wood Forum)
- FP industry needs to be more aggressive. Penalty for failed innovators is too high.
- Forintek and U.S. equivalent do a good job. Universities not needed in R&D role.
- But likes Centres of Excellence idea.

President of Manufacturing Company

- His products cost effective where labour costs are high (i.e. B.C.). Americans buy up second hand Cdn. equipment!
- E.D.C. no help and not needed. Do all business on a cash basis, including Australia and New Zealand.
- Strong liking and regard for customers and competitors.
- Government foreign deals spectacular failure.
- NEVER HAD A PROBLEM SELLING PRODUCTION PROTOTYPE. HAS TAKEN SOME BACK WHEN THEY DIDN'T WORK.
- Product ideas come from the customers. University research is irrelevant.
- Avoids government like the plague. The guy that fails is the guy with the government subsidy.
- Capital goods business in not a good business to be in.
- Tried to get customers to help finance important development 20 years ago. Disappointed that they didn't bite. Has not tried since.

Senior Consultant - International Consulting Company

- Foundries have gone, and the equipment business with it.
- Not enough R&D was done.
- Since they were "taken over" by a foreign (consulting) competitor, they have stopped bidding the equipment of one local manufacturer.
- VANCOUVER USED TO BE THE TOOLBOX FOR BOEING. THAT GAVE US AN EDGE.
- Thinks highly of the E.D.C. They press hard for Cdn. content.
- Scandinavian co-operative structure is breaking down.
- Thinks consultants have made major positive contribution to mfg. industry.

President and several colleagues - International Consulting Company

- Canada good at boilers (via U.S. owned company)
- Swedes much better salesmen.
- PAPRICAN has good ideas which don't get used.
- Svenke Flact is example of good company - solid technology, helpful, inspire confidence. Frank Murray (UBC - Chem. Eng) ideas re scrubbers adopted by Flact.
- Swedish refiners cost 30% more than Cdn. counterpart, but Swedes do more research, inspire more confidence, get sale.
- TAX STRUCTURE IS IMPORTANT. SWEDES FORCED RE-INVESTMENT.
- Best engineers don't go into pulp and paper. The FP industry is run by financial people.

Senior Vice-President responsible for Research - Integrated Forest Products Company

- we have missed the boat as far as conventional pulp machinery is concerned. We should be planning to get into new, high technology equipment.
- for large capital intensive pieces of equipment (such as paper machines), where the margins are narrow, the length of the start-up period is critical to getting an acceptable return on investment. Hence the need for conservatism in selection of equipment.
- virtually no advantages to having a local supplier.
- would help manufacturer sell equipment if there was something in it for the FP company, e.g. a royalty in cases where the equipment is jointly developed.
- major new product opportunities are in the solid wood sector where B.C. has a dominant market position. See opportunities particularly in applications of microelectronics and software.
- sees definite role for university research which "is coming along well now". Gov't research not effective in area of manufacturing, but important in areas of silviculture, pest and fire control, fisheries and wildlife.

- government should back the winners.

- the Swedes and the Finns have a structure and a culture which leads to better co-operation and understanding in the forest sector. The Chief Forester in Sweden attended university with many of the CEO's of the integrated FP companies, and deals with them on a first name basis. Consultation is natural.

President of Manufacturing Company

- patents are a vital element of success.

- current best product just getting into high gear after 12 years of development and sluggish sales.

- over 70% of sales outside Canada. Only two local FP companies buy product. Major sales are to the U.S., but has also sold to Japan, China and many other countries.

- originally sales were direct to the paper companies, now the paper companies specify their product as part of the deliverable from the manufacturer of the paper machine (e.g. Beloit, Voigth)

- had patent fight with Valmet and won.

- got no government help during the development of the product, it just did not fit their programs. But is now getting valuable help in marketing the product abroad.

- has got booth for exhibit at TAPPI in Atlanta (major U.S. pulp and paper exhibit), but cannot get booth space at corresponding show in Canada this year, and quite likely not next year either!

- quality of EDC activity very uneven. Every once in a while, there is a real gem. Often incompetent.

- product development research would be helpful, but market development assistance is even more important.

- all his products have an unconditional guarantee. If they don't work, he will take them back.

- now that many of the older engineers have gone from the mills, it is the maintenance supervisors who really know what is going on.

SUMMARY OF RECOMMENDATIONS

FROM ALL SECTORS

MINING, MINERALS, METALS

NEEDS

- INDUSTRY INVOLVEMENT
- NATIONAL CO-ORDINATION
- FOCUS ON R&D
- RAISING AWARENESS

RECOMMENDATIONS

- R&D CO-ORDINATOR FOCUSSED ON B.C. NEEDS, NATIONAL INTERFACE

- INDUSTRY CHAIRS - ADVANCED MATERIALS

- CENTRES OF EXCELLENCE:

  - ADVANCED MATERIALS
  - INDUSTRIAL MINERALS
  - GEOLOGICAL EXPLORATION
  - RARE & PRECIOUS METALS

AGRICULTURE AND FOOD PROCESSING

PRIMARY AGRICULTURE
- ROLE OF AGRICULTURE CANADA
- VERY SMALL AVAILABLE LAND BASE

SECONDARY MANUFACTURE
- POTENTIAL GROWTH AREA

FOOD PROCESSING
- POTENTIAL GROWTH AREA

RECOMMENDATIONS

- INTERFACE WITH BIOTECHNOLOGY
  - DISEASE CONTROL
  - GENETICS
  - WASTE MANAGEMENT
- VALUE ADDED
  - FOOD PROCESSING
- INCREASE PRODUCTIVITY
- INCREASE INDUSTRY INVOLVEMENT
  - CO-OPERATIVE RESEARCH

AGRICULTURE AND FOOD PROCESSING

RECOMMENDATIONS (CONT'D.)

- FUNDING FOR SECONDARY MANUFACTURE, FOOD PROCESSING
- RESEARCH ORGANIZATIONS STAFFING AND EQUIPMENT
- GENERAL AWARENESS
- TECHNOLOGY TRANSFER

ENERGY

MAJOR RESOURCE OF PROVINCE

DEPENDENCE OF OTHER RESOURCE SECTORS

OIL - IMPORT TO B.C.

NATURAL GAS SURPLUS

RECOMMENDATIONS

- OIL & GAS
  - DEVELOP UNDERSEA ROBOTICS
  - PREPARE FOR SWITCH AWAY FROM OIL
  - NATURAL GAS DIESEL ENGINE CONVERSION
- COAL
  - DEVELOP CAPABILITY TO ANALYZE COALS
  - BENEFICIATION & TRANSPORTATION
  - ALTERNATIVE USES

ENERGY

RECOMMENDATIONS (CONT'D.)

- WOOD RESIDUE AND BIOMASS
  - CONTINUE DEVELOPMENTS - METHANOL, ETHANOL
- OTHERS
  - HYDROGEN
  - FUEL CELL

SCIENCE & TECHNOLOGY ENERGY FOCUS

- CENTRE FOR ENERGY STUDIES
- BUILD EXPERTISE
- UNDERTAKE TESTS
- NATURAL GAS
- LONGER TERM ITEMS

AQUATIC RESOURCES

$750M INDUSTRY

AQUACULTURE - HIGH GROWTH
- SCIENCE ISSUES

RECOMMENDATIONS

- WATER QUALITY
  - SPECIFIC CONTAMINANTS
  - AQUACULTURE
- AQUATIC INSTRUMENTS AND DEVICES
  - INTERFACE WITH SECTOR
  - GROWTH AREA
- FISH HARVESTING
  - GOVERNMENT AND SOCIAL POLICIES
  - IMPROVEMENTS POSSIBLE
  - SHIP/SHORE COMMUNICATION

AQUATIC RESOURCES

RECOMMENDATIONS (CONT'D.)

- FISH PROCESSING
  - NEW PRODUCTS
  - BY-PRODUCTS
  - QUALITY
  - PACKAGING
- AQUACULTURE
  - INTERFACE WITH BIOTECHNOLOGY
    - DISEASE CONTROL
    - NUTRITION
    - GENETICS
    - WASTE MANAGEMENT
  - NETWORK OF EXCELLENCE

FORESTS AND FOREST PRODUCTS

GROWTH AREA

MOVING TO VALUE ADDED PRODUCTS

RESOURCE DIMINISHING AND MORE EXPENSIVE

WORLD-WIDE COMPETITION

DEPENDENCE ON SCIENCE & TECHNOLOGY

ADVANCED MACHINERY AND SYSTEMS

PEOPLE NEEDS

RECOMMENDATIONS

- OVERALL CO-ORDINATION FOR SCIENCE AND TECHNOLOGY
- ADD VALUE
- IMPROVE PRODUCTION FOR RESOURCE

Science Council of British Columbia

Helping Make Tomorrow Happen in B.C.

FORESTS AND FOREST PRODUCTS

RECOMMENDATIONS (CONT'D.)

- RAISE TECHNOLOGICAL AWARENESS AND COMPETENCE
  - RESEARCHERS
  - 'RECEPTORS'
- TECHNOLOGY TRANSFER
- USE OF ADVANCED SYSTEMS, TECHNOLOGIES AND MACHINERY

MANUFACTURING

IMPORTANCE TO PROVINCE

4,000 COMPANIES - 40 LARGE

LACK OF TRAINING

DIFFICULTIES OF LOCATING PARTNERS

TECHNOLOGY TRANSFER - SMALL COMPANIES

RECOMMENDATIONS

- STRATEGIC PLAN - 'CHAMPION'
- BIOMEDICAL DEVICES
- EDUCATION AND TRAINING
- TECHNOLOGY CENTRE
- RESOURCE INDUSTRIES - ROBOTICS
- NETWORKING
- CAD/CAM
- FUNDING

BIOTECHNOLOGY

EMERGING INDUSTRY - $12M

IMPACTS ON MANY SECTORS
- FORESTS
- AGRICULTURE
- AQUACULTURE
- HEALTH
- WASTE MANAGEMENT
- MINING

NEED FOR STRATEGIC PLANNING, CO-ORDINATION

RECOMMENDATIONS

- FOCUS ON
  - DISEASE CONTROL
  - GENETIC IMPROVEMENT
  - WASTE MANAGEMENT

- STRATEGIC PLANNING - USE OF EXISTING COMMITTEE

- LONG TERM COMMITMENT OF FUNDING

- RAISE FUNDING FROM $10M TO $30M - 5-10 YEARS

BIOTECHNOLOGY

RECOMMENDATIONS (CONT'D.)

- STRATEGIC RESEARCH, TRAINING, SCHOLARSHIPS
- INDUSTRY/UNIVERSITIES INTERACTION
- REVIEW FACILITIES NEEDS AND CO-ORDINATION

Science Council of British Columbia

Helping Make Tomorrow Happen in B.C.

INFORMATION TECHNOLOGY

$1 BILLION INDUSTRY

11,500 PEOPLE

25%-50% ANNUAL GROWTH

RESOURCE INDUSTRIES/INFORMATION TECHNOLOGY

PEOPLE NEEDS

CO-ORDINATED ACTIONS

RECOMMENDATIONS

- ENHANCE RESOURCE INDUSTRIES BY ENHANCING THE INFORMATION TECHNOLOGY INDUSTRIES
- COMMIT TO INFORMATION TECHNOLOGY
- MARKETING, MANAGEMENT, TECHNICAL PEOPLE
- CO-ORDINATION AND PLANNING ROLE
- INFRASTRUCTURE AND SUPPORT

EMERGING THEMES

- BUILD ON EXISTING COMPANIES, ORGANIZATIONS AND INDIVIDUALS
- ORGANIZED STIMULATION OF INTERACTION AND PLANNING WITHIN AND BETWEEN SECTORS
- RESOURCE INDUSTRY FOCUSSED, TECHNOLOGY DRIVEN CENTRES OF EXCELLENCE
- VALUE ADDED PRODUCTS FROM RESOURCES USING TECHNOLOGY DEVELOPED IN B.C.
- DEVELOP THE MARKETING, MANAGEMENT AND TECHNICAL TALENTS OF OUR PEOPLE
- EFFECTIVE USE OF SIGNIFICANTLY MORE R&D SPENDING